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CONTENTS

[The following are translations of selected articles in the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]

Development of Russian Space Science in Coming Decades Viewed

93UM0856A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 4-5

[Article by Doctor of Technical Sciences Professor V. Senkevich, chief of the division for comprehensive analysis of space hardware of TsNIIMASh [Central Scientific-Research Institute of Machine Building and Metalworking], under the rubric "Problems of the Sector": "The Horizons of Russian Space Science"]

[Text] Contemporary space science is a new form of human activity. It has unique capabilities to resolve practical tasks on a planetary scale efficiently, and to have an appreciable impact on many aspects of the life of society.

Thanks to the global nature of the operations, space hardware has a level of promptness and informativeness that is not available to ground systems. Only these systems make it possible to use properties of the environment beyond the Earth (vacuum, weightlessness etc.) for applied and scientific purposes, conduct research on surrounding space across the whole range of wavelengths and study the heavenly bodies that populate them, as well as make use of their natural resources in the future for the needs of mankind.

It is entirely likely that it will be deemed expedient to remove radioactive wastes with the aid of spacecraft, taking them to remote orbits in special containers until such time as we find ways of reprocessing and using those harmful substances. The guaranteed safe burial of radioactive wastes on Earth is impossible in practice, after all, at the contemporary level of development of science and technology.

The scope and level of worldwide space activity, at the same time, has now led to the appearance of specific problems that must be resolved without delay. "Space trash," for example (spent stages of launch vehicles, satellites, their constituent elements and parts and other "wastes"), has come to pose a real threat of collision with functioning spacecraft. The steady growth in the number of launches of launch vehicles requires the creation of ecologically clean methods of launch, and a reduction in the areas where the separated portions fall.

Domestic space science, as all of our country, is going through a difficult period today. A breakdown is occurring in cooperation that had taken shape over decades (more than a thousand organizations were directly active in it, and more than two thousand indirectly, in the former Union, although about 85 percent of the space potential was concentrated right in Russia). The former command-administrative system of command and control and the state financial and resource support of space science, with all of its merits and drawbacks, has been destroyed, and a renewed organizational structure is being created in its place. The government of Russia has already made concrete decisions in this area, the basis of which is the prospect of preserving space science as a sector that performs important state functions. The Russian Space Agency in particular was formed at the beginning of 1992, and was given the task by presidential edict of "developing and implementing state policy in the realm of the study and utilization of outer space."

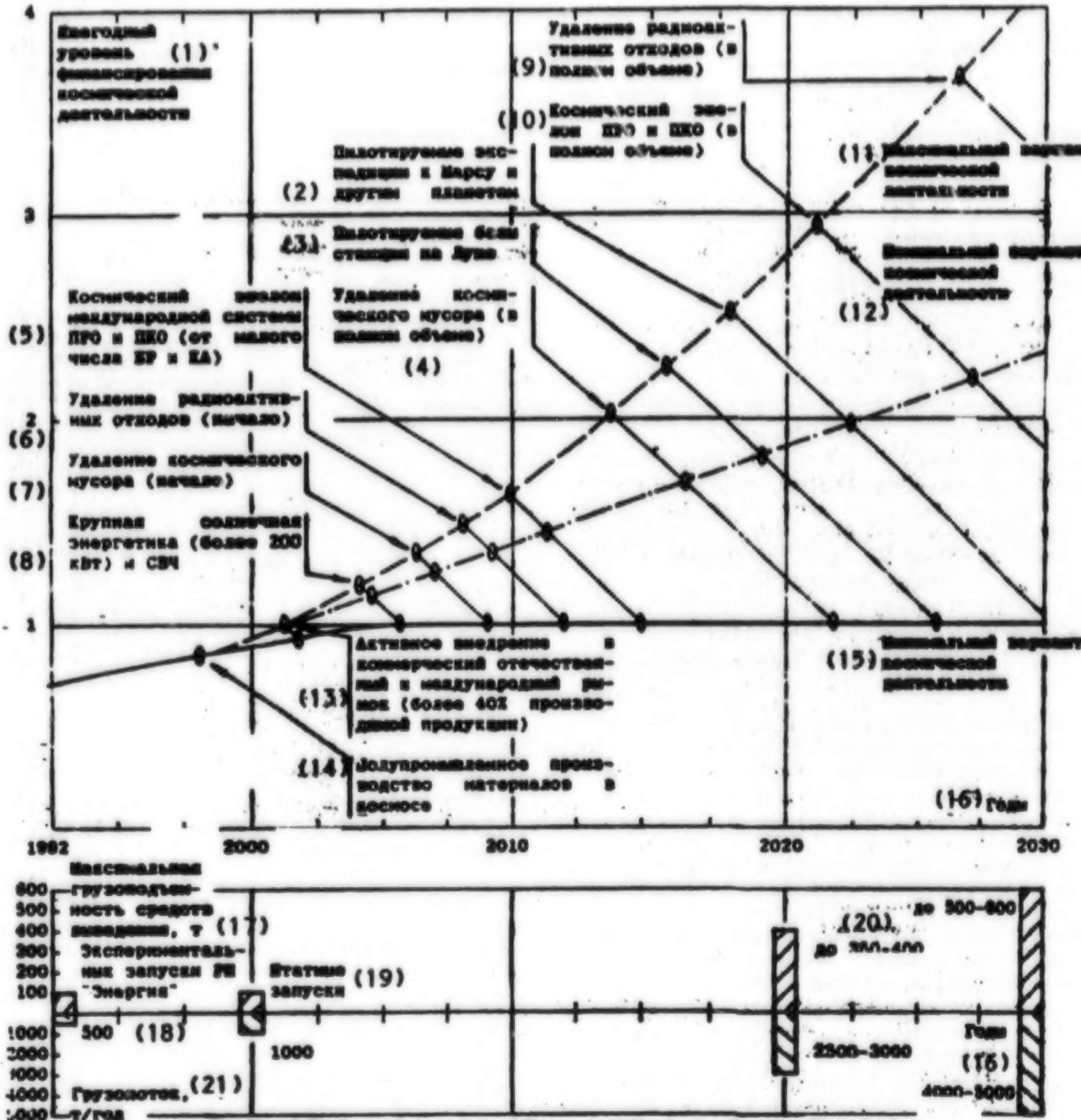
The problem of the right of ownership of elements of the space infrastructure located on their territories by the republics of the former Union—which never arose before—requires immediate settlement.

The financial and economic crisis and the drop in production in all sectors of industry are appreciably lowering the level of space activity. Spending declined by 35 percent in 1991 compared to the prior year. The work of the missile and space sector was effectively "frozen" for several months at the beginning of 1992, before the confirmation of the state order. Cutbacks and stoppages of theoretical and experimental work (whole areas are threatened in some cases) are occurring as a result, highly skilled professionals are leaving and the system of personnel training is being destroyed; it will be exceedingly difficult to restore our "space school," which is world class. The scientific and experimental physical plant is in grave condition owing to insufficient financing. Further strengthening of these negative elements could lead to Russia's loss of its position as one of the leading space powers, which is intolerable.

The contemporary situation, at the same time, brings new opportunities as well. The change in the socio-political situation in the world and reduction in the level of military confrontation are opening up broad prospects for international collaboration.

The processes of integration that are typical of all sectors of the economies of developed nations are now taking place at a worldwide level in space activity as well. There are opportunities to accomplish space projects that even the wealthiest country is in principle not able to carry out from a technical standpoint, and in the realization of which all of mankind has a vested interest. Virtually all large-scale programs at the beginning of the 21st century will now be accomplished on the basis of international financing, and joint plans for their fulfillment and utilization of the results. There are opportunities therein for collaboration for more than scientific and national-economic purposes alone. Prospects are already being discerned, for example, for the creation of a space echelon of international systems of missile and space defense, intended for monitoring arms and ensuring global security under the aegis of the United Nations.

Intensive commercialization is being observed in international space science, a market for hardware, technology and services is forming and the initial distribution of spheres of influence is proceeding. It is exceptionally important for Russia to take its place in this process right now. Its participation in the world space market, unfortunately, is still not large. The rapid



Predicted Tasks and Amounts of Space Activity in the Coming Decades*

Key:

1. annual level of financing of space activity
2. manned expeditions to Mars and other planets
3. manned lunar base stations
4. removal of space trash (completely)
5. space echelon of an international system of missile and space defense (from small numbers of ballistic missiles and spacecraft)
6. removal of radioactive waste (start)
7. removal of space trash (start)
8. major solar power engineering (more than 200 kW) and SHF
9. removal of radioactive wastes (completely)
10. space echelon of missile and space defense (complete)
11. maximum variation of space activity
12. nominal variation of space activity
13. active incorporation into commercial domestic and international market (more than 40 percent of products produced)
14. semi-industrial production of materials in space
15. minimal variation of space activity
16. years
17. maximum lift capacity of launch assets, tonnes
18. experimental launch of Energiya launch vehicle
19. standard launches
20. up to...
21. freight traffic, tonnes/year

*—Note: in accordance with the development trends of world space science.

and correct determination of which elements of domestic engineering and services have any demand, the finding of customers and the development of an intelligent pricing policy are essential in order to win a proper place in that market. The concept of "profit" in the sector of space science should become just as common as in any other.

What awaits us in the future? The Russian Space Agency, RF Ministry of Defense and Ukraine Academy of Sciences, in conjunction with other ministries and agencies, in 1992 prepared a series of documents on a new space policy, and in particular the "State Space Program of Russia to the Year 2000." It envisages measures providing for the development of our potential, its utilization for the resolution of scientific and national-economic tasks and basic research, the development of commercial entrepreneurship in various areas of space activity and the receipt of a real economic impact via the creation of new technologies, products and services and their offering to other sectors.

The concrete forms for realizing the directions of that activity depend on many factors, including on predicted technical development trends. Three principal ones may be singled out. Constant expansion of the sphere of application of missile and space engineering should lead to the creation of multipurpose orbital platforms, and their use to perform a large number of various tasks. It would be expedient therein to begin the interproject standardization and modular-unit execution of satellites and their constituent parts. Such an approach would permit a 20—30 percent reduction in spending on space science.

The second promising trend is the development of the principle of reusability. The operation of not only multiple-use systems such as the Buran and Space Shuttle manned spacecraft, but also the realization of new ideas such as the recovery of launch vehicles and their constituent parts using an aircraft configuration or using parachute descent, with their repeated launching, is being predicted for the future. The return from space of individual replaceable modules and units, apparatus or a spacecraft as a whole that would be put back into orbit after ground restoration is a matter for the near future.

Third, an essential element of the space science of the future is a system of transport and technical support and repair in space. Hangars, warehouses and other structures located in orbit are needed. Automatic robotic systems fitted with manipulators, mobile rocket trolleys for movements in space, truss elements and equipment for the assembly and repair of large structural elements, as well as the replacement of individual modules and instruments on satellite platforms, should be of assistance. Orbital stations of the Mir type or the American Freedom could become the bases for accommodating such facilities.

The cost recovery and profitability of space science will be achieved through the direct national-economic impact (including from the use of dual-purpose satellites), the organization of commercial activity, the transfer of promising space technologies to other sectors and the production of consumer goods by the enterprises in the missile and space complex.

The space programs themselves, however, will become more and more expensive, and the formation of a system that guarantees objective and full information for the public on the work in the principal areas of space activity of Russia and provides the opportunity to influence public opinion on its scope and the choice of ways of development is thus essential. The creation and active work of such independent and extrabudgetary organizations as the Academy of Space Science imeni K.E. Tsiolkovskiy, the International Engineering Academy, the Federation of Space Science of Russia and the Moscow Space Club, among others, could be considered the start of that.

The process of assimilating and utilizing outer space is proceeding, and will proceed, at an increasing pace. Both the preservation and the development of the directions of space activity that have already become traditional, along with the appearance of new ones, is being predicted after the year 2000. These are, first and foremost, the development of the space industry in near-Earth orbits, the creation of space solar electric-power plants and a space echelon of the international system of antimissile and space defense. The building of manned base stations on the moon will lay the foundation for the practical assimilation of its natural resources, and will be the first step in the realization of even more large-scale projects for manned flights to Mars and other planets.

Society's need for such programs seems obvious, and will be satisfied only with sufficient financial and resource support from the state.

Problems, Prospects of Russian Space Science for the Long Term

93UM0856B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 6-7

[Article by KIK [Command, Control and Telemetry Complexes] Main Center Chief Colonel Anatoliy Borisovich Zapadinskiy under the rubric "In the Space Units": "The Main Center"]

[Text] *The problems of the Main Center of the command, control and telemetry complexes (KIKs) have been written about for a long time. Most features devote particular attention to the organizational, technical and financial issues connected with the collapse of the USSR. That is not surprising. Several of the command, control and telemetry complexes, after all, have ended up on the territory of states in the near abroad. But the KIKs are, first and foremost, a collective of highly skilled specialists about whom the general public knows virtually nothing at all. They remain outside the view of reporting from Baykonur, Plesetsk and the Flight Control Station for the Mir orbital station.*

The journal is beginning the publication of a series of materials on the service of the workers at the command, control and telemetry complexes and their role in supporting the space programs and raising the combat readiness of the armed forces of the Russian Federation with this article by KIK Main Center Chief Colonel Anatoliy Borisovich Zapadinskiy.

The Main Center for the Testing and Control of Spacecraft is located near Moscow in the city of Krasnoznamensk (Golitsino-2). The city was closed to journalists until quite recently, and not just to them. Military specialists of the highest qualifications are on duty here around the clock—electronics experts, programmers, ballistics specialists, communications workers and many more, for whom space is the cause of their life. These people are responsible for the state of almost all of the country's orbital stations, manned or unmanned, for military, national-economic or scientific-research purposes. Information flows from twelve command, control and telemetry complexes located across the entire territory of the country to the Main Center, which is a very important part of the Military Space Forces of the Ministry of Defense of Russia, as well as from scientific-research vessels (separate ocean-going floating complexes) through relay satellites. The Flight Control Centers for the separate types of spacecraft are structurally part of it. They plan about 1,000 communications sessions with more than 180 craft in orbit each day.

The command and control of spacecraft that are in service is just a part of their tasks. A second, and perhaps no lesser, part is to conduct flight testing of new spacecraft. The specialists of the Main Center perform these functions in collaboration with representatives of more than 150 organizations—NIIs [scientific-research institutes], KBs [design bureaus], NPOs [scientific-production associations] and civilian agencies.

A satellite flies over the territory of Russia for about 20 minutes, and the control and telemetry complexes are "receiving them" and "handing them over" to each other successively along the entire track, each of them having its own zone of radio visibility with a certain overlap; the control of the craft thus continuously passes "by relay." And so it goes around the clock.

The collectives, supervised by Colonels V. Kovalev, A. Kotenko, V. Artemenko, N. Kolesnikov, I. Lopatin and V. Pestov, are successfully accomplishing the tasks assigned to them under difficult conditions. There are 67 officers with academic degrees of doctor or candidate of sciences currently serving at the Main Center. They are making a large contribution to the scientific-research work of the command and control centers. I would like to note among them S. Ryapolov, O. Pudovkin, O. Yefremov, M. Grekhov and Ya. Abdulov first and foremost.

The uninitiated reader could ask, "What do I in particular, and the country in general, need with space science, since it costs enormous amounts of money?" I will try to answer that.

When you open up a recent newspaper, turn on the television or reserve a telephone conversation with a different city, you scarcely give any thought to the fact that space telerelay currently supports the transmission of Channel 1 from Ostankino for 97.2 percent of the population and the Russia Channel for 90 percent, 29 cities receive images of newspaper column layouts through satellites, and telephone, telegraph, facsimile and other forms of communications are accomplished by satellite. The economic impact from the use of those means alone is about 1.5 billion rubles a year.[1]

Orbital weather stations provide timely warning of dangerous natural phenomena, and markedly improve the accuracy of forecasts. The annual economic impact from their use totals more than 500 million rubles, and the research data on natural resources about 700 million. More figures from the realm of space meteorology: one satellite receives more information in 90 minutes (the average duration of one orbit around the Earth) than 1,500 weather stations around the world. The possibility of forecasting the weather two weeks in advance, according to the estimates of UN experts (and they can scarcely be suspected of bias), could provide an annual economy of about nine billion dollars on a worldwide scale. That figure is 600—700 million rubles a year apropos of our country.

Take, by way of example, an area of space science such as researching the natural resources of the Earth from space. This is a gold mine! The high-precision cataloguing of pasturelands and tracts of timber, predictions of spring water runoff and harvest levels of grains, after all, also exist aside from the aforementioned "line items" of income.

They have long since learned to count "space" money abroad. They know very well there that the cost of one photograph that encompasses 185 km^2 of the Earth's surface in stereoscopic form costs more than 4,000 dollars. The productivity of one spacecraft is more than 30,000 pictures a year.

Less than four billion rubles a year were being allocated for space programs by the former USSR in 1990-91. This is roughly half the spending of the state for tobacco products, and one seventh of that for alcoholic beverages.

The sensible voices of specialists from many of the agencies in whose interests the dozens of spacecraft and thousands of KIK specialists are working are most unfortunately not always heard against the background of the shrill declarations of some "people's patrons" who are calling for reductions and cuts in the space programs. They have been cut back as a whole. And what of it? Was there a spurt in some other sector of the national economy? No. Would it not thus be easier at least to preserve what we have, and find a worthy and economically advantageous application for it? We cannot in fact return to the plow and torch, leaving the country without communications, television, navigation, meteorological observations and many others services that often go unnoticed that are offered by space science.

Many forget, when talking about the commercialization of space science and its cost recovery, that there is also another aspect that for us, servicemen, is the main one, whatever else may be said on this score.

The positive changes in the world have naturally lessened international tensions appreciably. But the dissolution of the NATO alliance did not follow the collapse of the Warsaw Pact, and no substantial changes are taking place in the military doctrines and strategic concepts of the United States and the NATO countries.

Each looks after his own, as they say. It is the business of policy makers and diplomats to provide for the security of the state using peaceful means. It is the business of the military to support those efforts. How can space science help? The responsibility of military space science is global high-precision navigation, communications, the command and control of troops, operational all-weather reconnaissance and warnings of nuclear-missile attack, the monitoring of "hot spots" and the course of fulfillment of treaty obligations. We will be candid- -the space assets, in performing the total monitoring of the situation around the world, play a dual role. The national space assets of the great powers, on the one hand, foster a strengthening of strategic stability and confidence-building measures among peoples and, on the other, increase the combat capabilities of the troops by one-and-a-half to two times. The on-board apparatus of the reconnaissance satellites, in orbits of 300 km or more, in fact have resolution that allows them to see objects of just several dozen centimeters. Measurement data from special spacecraft are used to create the digital terrain maps that constitute the foundation of the flight assignments of the newest strategic arms systems. For cruise missiles this signifies the guaranteed hitting of the target with a deviation of no more than ten meters.

The operations of the United States in the war with Iraq is an example of this. They have in operational use 17 supporting space systems for military purposes today. These are satellites for imaging, infrared, radio and radar reconnaissance on global and regional scales, the monitoring of outer space and the warning of nuclear-missile attack, communications, combat command and control and navigational, topogeodesic and meteorological support. The U.S. Department of Defense could bring in civilian space assets as well when needed.

I would like to emphasize here the substantial difference of our "space system" from the American one. We have no separate military and civilian space science. The spacecraft, regardless of their purpose, are thus prepared and launched from one and the same cosmodromes by one and the same launch vehicles. Ground stations and information-computer complexes belonging to the Ministry of Defense of Russia control them. Why not now split up the zones of responsibility and turn over national- economic and scientific space science to civilian agencies, leaving the military with purely their own tasks? With time, when private companies begin to invest funds in space science, this could become a reality, but now—we will be realistic—there is not one civilian specialist who would go to work and live at a cosmodrome or ground telemetry station for the same money, and under the same conditions, as our officers. Colossal funds will be required in order to create a separate civilian space science. I think that this question will not be considered in the near future. Thanks to the fact that domestic space science is being kept on the backs of servicemen—whose monetary sustenace is less than the wages of a trolley driver—living in God-forsaken places and who do not have normal housing, but do not go on strike nonetheless, it remains with those few that are still working uninterruptedly here.

We are constantly called upon to perform tasks associated with maintaining the combat readiness of the armed forces of the Russian Federation. And that is not easy work. Dozens of spacecraft for various purposes are prepared and launched at our cosmodromes every year, and the KIK Main Center is constantly controlling the spacecraft in orbit. The military people work with such far from military spacecraft as the Molniya and Gorizont (communications), Tsikada (navigation), Meteor and Resurs (meteorology and remote sounding of the Earth) and scientific satellites. They support the launch and control of all manned flights. And meanwhile no one removes their main task—ensuring the security of the Fatherland.

The cutbacks in the personnel of space units that were carried out in directive fashion a few years ago have created a situation close to critical. Many officers at the command, control and telemetry complexes put in day-long duty a day later, are brought in for additional work at night and take part in controlling communications sessions for two or three days without a break. The psychophysical burdens are enormous. Operations where each mistake could caused millions in losses to the state are performed during these sessions.

It would be convenient here to mention the prospects for the development of the KIK Main Center and questions of the social protections for the people who are serving the Fatherland—to its "greater glory," as they said in the old days. The prospects, strange as it may be, are defined by our problems. The facilities of the space infrastructure are located on the territory of five states of the CIS (Russia, Kazakhstan, Ukraine, Belarus and Uzbekistan). Only one of those—Russia—is able to carry out space activity independently. Kazakhstan, where Baykonur is located, does not have any space industry and cannot operate the cosmodrome independently of the other states. There are missile- building plants on the territory of Ukraine, but no cosmodrome. So what is the way out? Operations in the realm of space science must be organized in a new fashion, and coordinated with the space programs of sovereign states and the international space program. Such programs are expediently developed from the perspective of a decade, since the cycle for the creation and series production of space assets is 7—10 years. The necessity of a state program is conditioned by two factors. Some space systems, first of all (meteorological, navigational etc.), could serve a virtually unlimited number of consumers in all parts of the Commonwealth. It would not be expedient to create them for each state separately. Second, the centralized financing of military and international space programs should be preserved, from the economic and technical points of view.

An International Aerospace Committee (MAKK) must be formed. It could be entrusted with the functions of general customer of international space projects, as well as being the body that determines the degree of participation of states in shared financing for the creation and operation of space assets for dual purposes.

Responsibility for the fulfillment of the international space program should be charged to the Military Space Forces of the Ministry of Defense of the Russian Federation, entrusting it with ordering and operating space assets for military and dual purposes. The involvement of space units in realizing the plans of space agencies of the sovereign states and the MAKK could be accomplished on a contract basis, with compensation for the expenditures of military organizations for the creation and operation of the hardware, as well as the maintenance of the service personnel.

Footnote

1. Here and below 1991 prices are given.

Overview of Physical Layout of Baykonur Cosmodrome

93UM0856C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 8-9

[Article by Candidate of Technical Sciences Major-General V. Menshikov under the rubric "Cosmodromes: Rockets and People": "Baykonur"]

[Text] *Taking into account reader interest in the previously closed topic of the locations, layout of the facilities and activity of the Military-Space Forces of the Ministry of Defense of the Russian Federation, we are beginning the publication of materials on the cosmodromes.*

The Baykonur cosmodrome is an enormous scientific and technical complex. It is located on desert terrain in the central portion of Kzyl-Orda Oblast. About 40 rockets for space purposes and up to 10 intercontinental ballistic missiles are launched from it every year.

The grounds of the cosmodrome (which extend 85 km from north to south and 125 km from west to east) have launch pads and engineering positions, receiving and transmission centers, wireline communications centers, storage areas for rocket and space hardware, fuel components, systems for electric-power, heat and water supply, an oxygen-nitrogen plant—one of the largest in the world for the production of cryogenic products—and other facilities. Baykonur is comparable in the scale of production and consumption of electric power to a sovereign state such as Moldova. The cosmodrome has five telemetry stations and a computer center, as well as nine telemetry stations along the flight paths of the launch vehicles for 1,500 km along the territory of Kazakhstan and Russia, as well as areas for the spent stages to fall.

The population of the city of Leninsk and the residential compounds of the centers for the preparation of launch vehicles and spacecraft for launch fluctuates, depending on the tasks being performed, from 120,000 to 150,000 people.

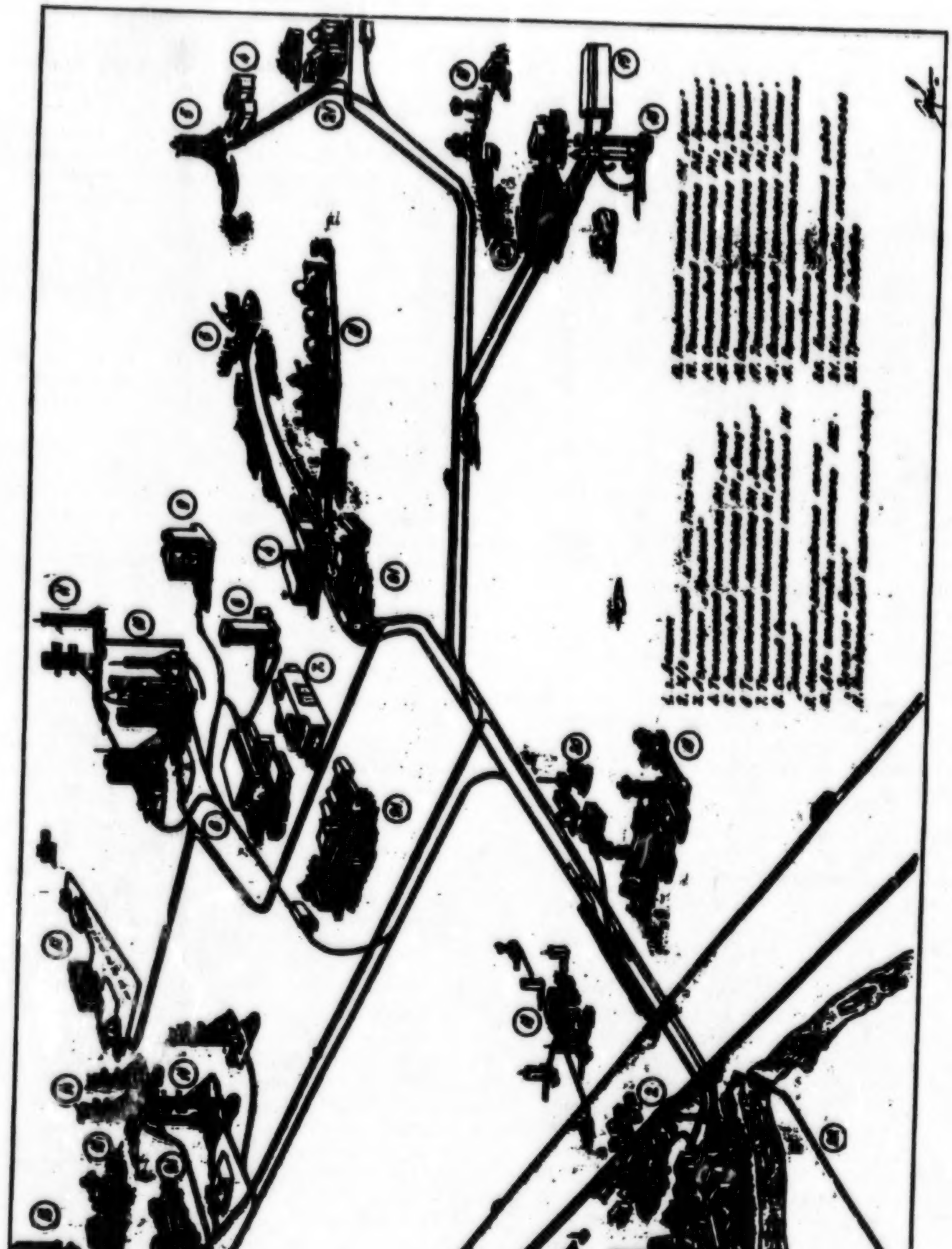
All of the facilities are traditionally divided by the residents of Baykonur into "ten," the "left" and "right" flanks and the "center."

"Ten." The city has a quite well-developed infrastructure—the Krayniy airfield, a TETs [heat and electric-power plant] (12 power boilers and eight turbines), branches of the MAI [Moscow Aviation Institute] imeni S. Ordzhonikidze and the Progress Plant (city of Samara), a bread-baking plant, movie theaters, a swimming pool, a television station, communications and domestic-services enterprises and various sights, as well as parks and squares that are artificially irrigated in the summertime.

"Left flank." The launch and engineering complexes for the Tsiklon and Proton launch vehicles and the spacecraft that they put into orbit is located about 70 km northwest of the city of Leninsk.

Elements of the former are located in compact fashion at a single site. The rocket itself is exceptionally reliable. Created by the KB [design bureau] under the supervision of Academician M. Yangel in the middle of the 1960s, it has not suffered a single accident right up to the present day. The launch complex is convenient to operate and highly automated. Satellites with nuclear power plants were launched from here in the 1970s, which caused great unpleasantness when they failed in orbit. They are no longer employed today.

1. city of Leninsk
2. Tyura-Tam railroad station and settlement
3. Krayniy airport
4. Soyuz launch vehicle engineering complex
5. Soyuz launch vehicle launch complex
6. Energiya launch vehicle engineering complex
7. Buran orbital craft engineering complex
8. Energiya launch vehicle dynamic test bed
9. installation and refueling wing
10. two launch complexes for Buran/Energiya reusable space system
11. general purpose launch bed
12. Buran orbital craft landing complex
13. Proton launch vehicle engineering complex
14. Proton launch vehicle launch complex
15. Zenit launch vehicle engineering complex
16. Zenit launch vehicle launch complex
17. Tsiklon launch vehicle engineering complex
18. Tsiklon launch vehicle launch complex
19. cosmodrome telemetry complex stations
20. oxygen and nitrogen plant
21. residential compounds of test personnel
22. water line right-of-way



The principal rocket and space complex for which the "left" flank is renowned is the Proton. It includes two launch areas with four launch pads, a refueling and neutralization station and an engineering position with two installation and testing wings. The residential compound is designed for 10,000 people.

"Center." The launch and engineering structures for the Soyuz and Energiya launch vehicles, the spacecraft they put into orbit and the Buran orbital vessel are all located here.

The famous "two," with the Gagarin launch pad, two installation and testing wings, a hotel, guest cottages, a museum of cosmonautics and the cabins of S. Korolev and Yu. Gagarin, is located 30 km from Leninsk. The daring assault on the universe began here. Soviet and many international crews that brought honor to our state "left" for orbit from this launch pad.

The ground elements of the Energiya/Buran reusable space system are located alongside "two," where the structures of the king of rockets—the N-1—run along the main road for a distance of more than 15 km. The launching set-up, a service tower shortened by 60 meters and the moving portion of the rocket erectors have been partially utilized from the N-1 equipment. All the rest had to be created anew. This most complicated ground complex occupies an area of more than 10 km^2. It consists of several dozen structures and more than 50 technological and 200 engineering systems. Two identical launch pads are located here. They are served by a cryogenic center located to the north, with storage areas (spherical containers 12 meters in diameter) for liquid oxygen and hydrogen and gaseous nitrogen and helium (pressure in the tanks 400 atmospheres).

The launch structure goes down five stories. It is a reinforced- concrete structure with monitoring and check-out apparatus, elevator equipment, massive protective doors weighing two tonnes apiece, a gas offtake port 20 meters in diameter, three gas offtake channels 23 meters deep and two masts 64 meters high. One of them is for refueling and drainage. One feature of it is that it has a platform that is removed only after the start of rocket movement, so as not to permit the displacement of the hydrogen with atmospheric air, the formation of "knall gas" and an explosion. The other tower is intended for putting the orbital crew into the spacecraft, or for their emergency evacuation through two elevator tubes that lead to bunkers. One tube has a lift and a rail car designed for twelve people, for bringing the cosmonauts up. The other is for emergency evacuation, in which people slide downward in a sitting position as in an ice slide. Each crew member lands in a separate bunker below, with a closing iron door.

Two railroad tracks 18 meters apart run to the launch structure. The reusable space system is delivered along them to the pad by four powerful diesel engines from the installation and refueling wing on a placement unit. The total weight of the moving structure is about 10,000 tonnes.

The launch-complex systems are automated, and are controlled from a command post located five kilometers away. It is a three-story subsurface building with an enormous (100 x 50 meters) central hall. The electric power consumed at the launch pad during times of operation would be enough for a city of a hundred thousand. The composition of the reusable space system, apart from the pad, includes a general- purpose pad intended for launches of the Energiya/Buran system, as well as the test-bed and technological testing of rockets, firing and post- flight testing of its side units as part of the technological package and test beds for the Energiya with a mock-up of the Buran orbital vessel. It was built before the launch complexes.

The landing complex is located 12 km northwest of the pad. The runway is unique, with a length of 4,500 meters and a width of 84 meters. The surfacing is up to half a meter thick. The deviation from the horizontal is no more than three millimeters on a three-meter section of the runway's length, which is a third of that at the international airfield at Sheremetyevo. The servicing and engineering area of the landing complex supports the unloading of fuel components from the orbital craft, loading operations and the storage of ground servicing equipment. Stations for the receipt and processing of telemetric information, a main hall for control and analysis, a set of navigational and landing systems, a meteorological center and an ornithological service are accommodated in a six-story combined command and dispatching station.

The engineering complex for the Energiya and Buran includes operational and production zones located 40 km from the city of Leninsk and 5 km from the launch pad.

The operational zone is made up of an installation and refueling wing, a refueling station and a pyrotechnics station, while the production wing has an installation and testing wing for the launch vehicle and the orbital craft. All of these structures are of truly cosmic dimensions. The installation and testing wing for the Energiya, for instance, was built for the N-1 launch vehicle, and is the largest building at the cosmodrome. It is 240 meters long, 190 meters wide and 47 meters high. There are more than 2,000 people working in it during periods of intensive preparations. The installation and testing wing for the Buran is a structure 225 meters long, 121 meters wide and 30 meters high. The Buran complex also has a dynamic-testing test bed—a building more than 100 meters high.

The barracks and residential compound is able to hold up to 20,000 people, residing there permanently or coming in for temporary duty of several years.

"Right" flank. A second complex for "seven," analogous to the Gagarin launch pad, is located 50 km southeast of the city of Leninsk. It entered service in 1960 and was intended as a back-up for "two," and was built with a regard for prevailing experience—the excavation was twice as large, and the installation and testing wings and the residential areas were brought closer to the locations

for the preparation and launch of the launch vehicles and spacecraft. Manned launches were also made here, but it was primarily spacecraft for interplanetary flights—Venera, Mars, Phobos and Vega, among others—that were prepared here. More than 330 launches were made in all.

Ten kilometers from this pad is the Zenit complex, consisting of a launch installation, a cryogenic center and more than 50 technological systems. All of the operations in the transporting, placement of the rocket on the launch installation, hook-up of electrical and air lines and fueling are performed automatically, and the rocket can be launched an hour and a half after placement. Service towers will be put into operation at the launch pad, through which the placement of the cosmonauts into the craft will be accomplished, when the Zenit becomes the principal launch vehicle for manned space flight, replacing the famed "seven."

The cosmodrome is in a difficult situation today, suffering from shortages of people, resources and funds and experiencing organizational and financial difficulties. The future of space science for the CIS countries depends on how these problems are resolved in the future.

Gonets Satellite System to Provide Cheaper, Simpler Communications

93UM0856D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 13-15

[Article by Candidate of Technical Sciences V. Vlasov under the rubric "Space Science for the National Economy": "The *Gonets* of 'SmalSat'"]

[Text] The development and adoption of satellite communications systems using geostationary orbits and small ground receiving stations is underway in many of the developed countries. Even the smallest stations, however, have antennas that are one to three meters in diameter, weigh several dozen kilograms and cost 20,000—50,000 dollars, as well as requiring skilled servicing and being inaccessible to the mass user. Further improvements in the characteristics of the ground terminals and provision for their widespread accessibility are possible only by making the satellites substantially more complicated, giving them antennas on the order of 30 meters in diameter, power consumption of several kilowatts, mass of four to six tonnes and expensive means of launch.

Broad research has been launched of late to create space communications systems using low-orbital satellites located much closer to the Earth than geostationary ones, requiring smaller power expenditures for the transmission of messages on the part of both the spacecraft and the ground stations. This would make it possible to provide communications between personal terminals that are close in complexity, dimension and weight characteristics to police mobile communications sets.

All of the low-orbit space communications systems that are now being developed can be divided into systems for the packet transmission of data and radio-telephone communications. They are distinguished by the services offered and the complexity of technical realization.

The former group includes such systems as the Gonets project, developed by the NII [Scientific-Research Institute] of Thermal Processes (Moscow) and the NPO [Scientific-Production Association] of Applied Mechanics (Krasnoyarsk). The customer is the SmalSat Intersector Business Association. The system should unfold in stages, will enter service in 1994-96 and will make it possible to transmit any messages in digital form (telex, text or image), exchange information between databases and computers and gather information from environmental monitoring systems or personal queries of subscribers, as well as determine the location of a mobile terminal and transmit that information to the center.

Some waiting time for a communications session could be permitted when offering services through this system, and strict demands will not be posed for the promptness of information transmission. An orbital group of satellites without a complex system for orientation and stabilization is thus not used when it is deployed. This makes it possible to refrain from using engine installations on the spacecraft, and to employ the simplest (gravitational) single-axis orientation system. The number of craft in the system is determined by the parameters of the orbit and the time for the waiting and delivery of information. The satellites are distributed on six orbital planes that are spread equally across the longitudes of the ascending node. The group could be controlled from a single point.

The 312—315 MHz and 387—390 MHz low-frequency bands allotted for the Gonets system, and the circular orbits at altitudes of 1,300—1,500 km that were selected, make it possible to employ wide-beam antennas with a gain of up to three decibels and transmitters with a power of 2—10 watts on the spacecraft.

The packet mode of data transmission, first of all, makes it possible to conserve power for the satellite and the receiving station and, second and most importantly, to conduct the communications sessions over brief time intervals using one satellite, without coordinating the operations of regional stations for session times. This simplifies considerably the organization of communications.

The adoption of these principles for structuring the low-orbital system of data transmission had the following results. The Gonets is indeed small and inexpensive. The low weight of the satellite (220 kg) and low orbits make it possible to arrange the orbital group by means of the simultaneous launch of six craft by a single Tsiklon launch vehicle. This determined the low cost of creating the space segment. The ground terminals make it possible to allow untrained support, and are oriented toward the user, cheap and do not require a far-flung infrastructure of ground communications lines.

Communications are conducted in close to real time within a region whose diameter is less than 5,000 km (the radio visibility footprint of one satellite). This occurs as follows. The spacecraft periodically emits a marker signal that contains the technological information necessary for a subscriber to establish communications (Fig. 1). During a time interval when the whole region is in the zone of radio visibility of the satellite, an address flag of the given region appears in the marker signal and the stationary (AT-S) and mobile (AT) terminals exchange information between themselves (the waiting time for a communications session is no more than 20 minutes with a probability of 0.8). The address flag can be formed by computer gear on the spacecraft or a regional station (RS). The latter method is simpler, and has been adopted in the Gonets system.

If the subscribers are in different regions, the information is transmitted in the "space mail" mode. The message transmitted to the satellite is recorded and transmitted to the recipient when he appears in the zone of radio visibility of the spacecraft. The average time to deliver information in that case does not exceed three to six hours.

The Gonets system provides for determination of the position of mobile subscribers, and the transmission of that information to the centers of the corresponding services. Two variations are possible. The use of terminals from the Glonass or GPS navigational systems is necessary for mobile targets that require determination of the geographical coordinates with a precision of a few meters. The terminals are hooked up using the standard RS-232 interface. If a precision of just 1—7 kilometers is required, the Gonets terminal is employed directly; it performs calculations based on measurements of the Doppler frequencies at several points in the satellite orbit and the current parameters of its movement.

The launch of two experimental Gonets-D satellites was made on 13 July 1992 in order to demonstrate the capabilities of the Gonets system and to try out the principles of its operation. The experimental system can currently function successfully in the mode of regional communications between the cities of Cheboksary—Izhevsk—Moscow, as well as in the "space mail" mode between Melbourne and Moscow. The launch of six

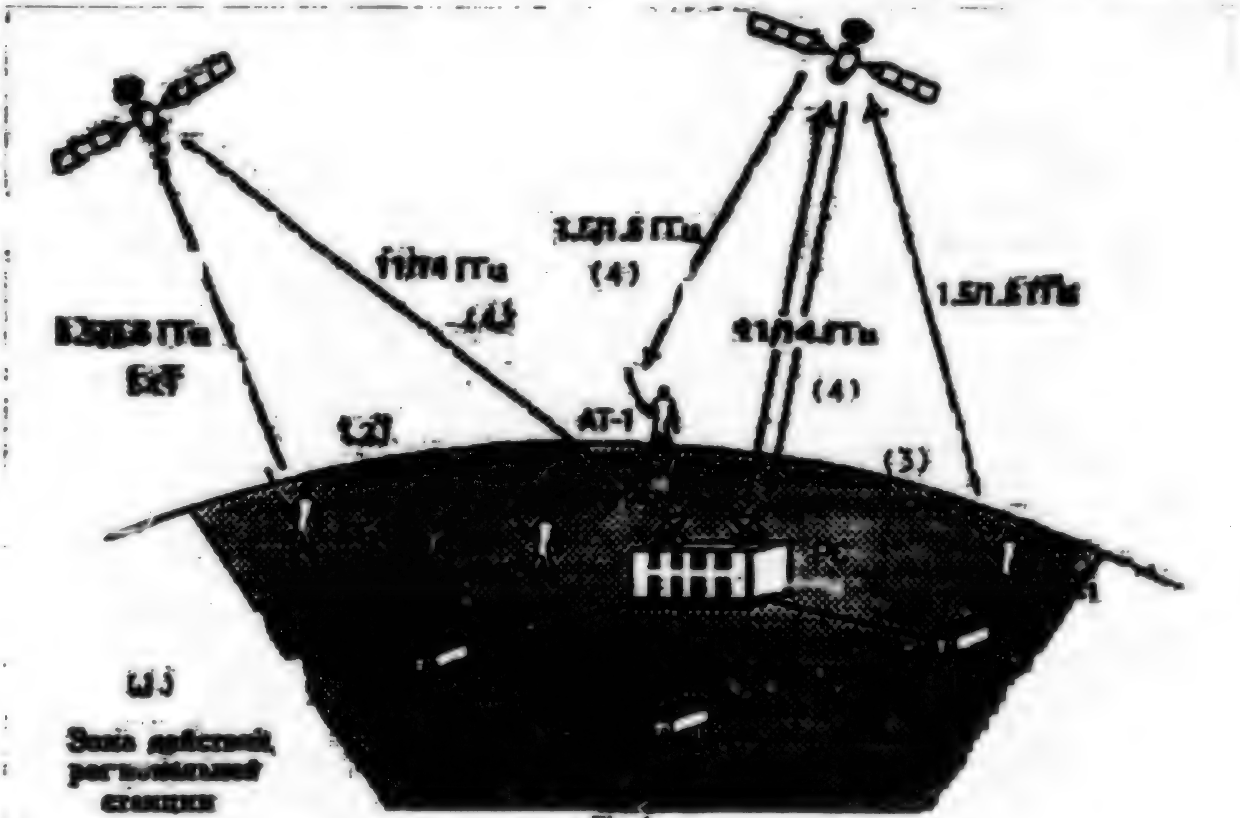


Fig. 1.

Key:
1. operational zone of regional station
2. subscriber terminals
3. regional station
4. GHz

Gonets-D1 experimental satellites in 1993 is being proposed to offer services to actual users.

The class of low-orbital systems for radio-telephone communications includes the Gonets-R project, which in addition to the indicated services provides for the exchange of voice messages with the use of personal radio-telephones.

The specific nature of the structure of the low-orbital systems of radio-telephone communications is determined by the requirement for uninterrupted support for users in real time. The orbital group should provide a constant scan of a service zone of the Earth's surface with a probability of no worse than 0.995 accordingly.

These features require the use of an orbital group of controllable satellites, the realization of a three-axis orientation system on the spacecraft and equipping them with engines. These craft turn out to be complex and expensive, and weigh no less than 400 kg. The group has to be controlled from several points, while the assurance of uninterrupted communications would require a large quantity of regional stations with expensive switching equipment. The cost of the system, according to some estimates, would exceed the cost of the packet data transmission system by 10—100 times.

Great interest is being displayed in low-orbital radio-telephone communications systems around the world. This is caused by the fact that cellular telephony systems using personal radio telephones, by and large, function in regions with medium or high population density and cannot offer their services in other regions, as well as to means of transport that are traveling across enormous territories.

The number of users of a low-orbital radio-telephone communications system, according to the estimates of experts, could reach several millions by the year 2000. This is roughly 100 times less than the number of users of cellular telephone systems. They will thus not be competing with the cellular telephone systems, but rather supplementing them.

Taking this into account, it is essential that the technical gear be compatible with cellular telephony and voice communications that are accomplished through personal or portable radio telephones. The maximum utilization

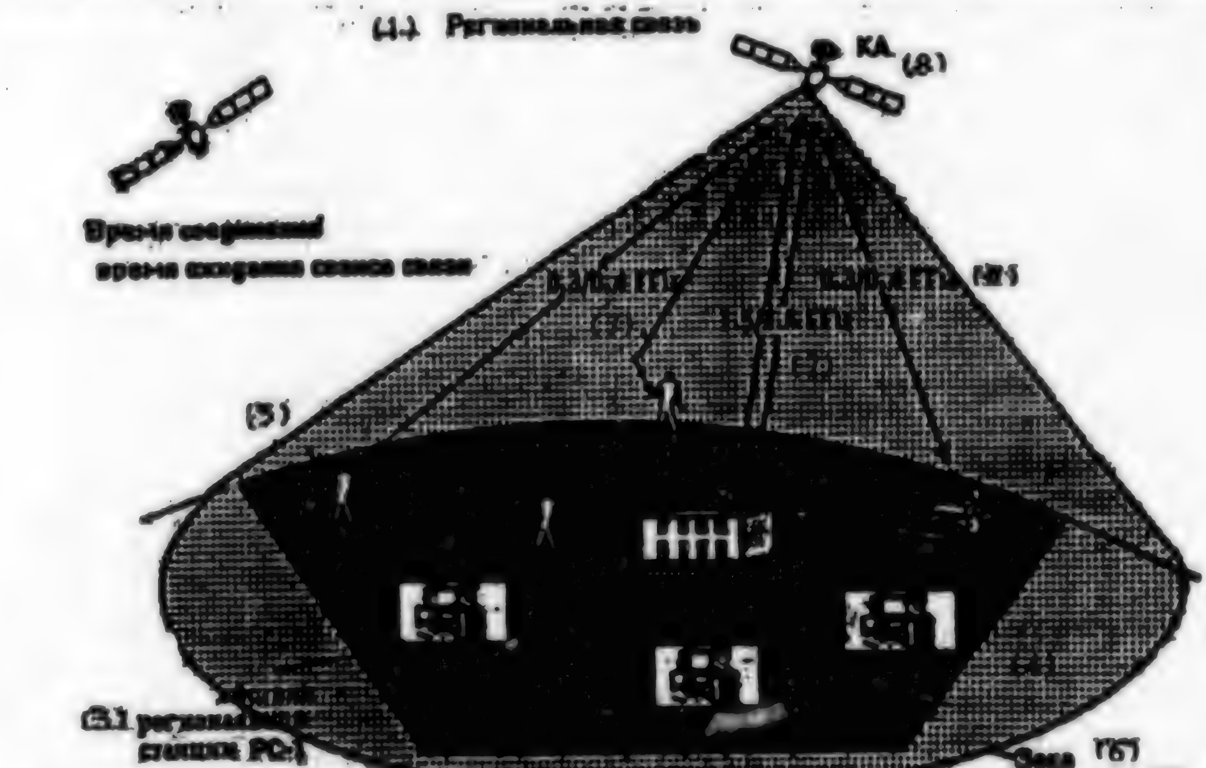


Fig. 2.

Key:
1. regional communications
2. time of link-up—time waiting for communications session
3. operational zone of regional station RS-1
4. RS-1
5. mobile subscriber terminals
6. zone of radio visibility of spacecraft
7. GHz
8. spacecraft

of the proven technologies of cellular systems will reduce the cost of creating the system as a whole, and will provide additional conveniences for the users.

The requirement for global servicing of users in real time could be met with the use of intersatellite communications channels in the system, or the means of other systems without them. The choice of method is made proceeding from the traffic (intensity) of user operations. Up to 90 percent of the traffic, as a rule, lies in a service zone of the Earth's surface of 4,000—5,000 km in diameter, and the variation for arranging the communications system without intersatellite channels is preferable.

The placement of a regional station in each such region is required, in that case, to support communications (Fig. 2); it maintains communications with all of the satellites covering the given region with their antenna patterns. The regional station links the subscribers of the system with each other through satellite channels within the given region, as well as provides connections with the subscribers of other regions or with subscribers of general-use networks by involving the means of other systems.

This organization of communications assumes that all of the subscriber connections are made through the regional station. The relay on the satellite should be without signal demodulation and decoding therein. The spacecraft is simplified, and various regions can operate with various coordinating devices (network protocols), providing an opportunity to utilize all existing switching equipment and simplify the creation of the system.

The SmalSat Association is currently studying questions of creating the low-orbital Gonets-R radio-telephone communications system using the indicated principles. The following preliminary results have been obtained. The space segment should consist of an adjustable orbital group of 45 satellites located on five planes of nine spacecraft each. The planes are 36° apart in ascending node longitude, and are polar circular orbits at an altitude of 1,500 km. The orbital group selected will provide for continuous coverage of a global service zone with an elevation of 10° with a probability of no less than 0.995. The satellites will have a mass of no more than 950 kg, an average energy consumption of 640 watts per orbit and an active existence of five years. A thirteen-beam antenna system with a gain of 8—13.5 decibels will be used on the spacecraft with subscriber radio lines (15—16 GHz band), while those with trunk radio lines (11—14 GHz band) will have a wide-beam antenna system with a gain of up to six decibels.

The parameters of the orbital group and the satellite will support the operation of 24,500—28,080 digital voice channels (546-624 per craft) with an information speed of 6.5 kB/sec in a frequency band of 5.5—11.7 MHz for subscriber radio lines and 38.5—81.9 MHz for trunk lines. The system will employ multiple-station access with time (MDRR) and frequency (MDChR) channel separation. The number of carrier frequencies on all radio lines is 39.

The Gonets-R system could go into service in 1997-2000, but additional study aimed at confirming its economic expediency is required before a final decision is made.

Kaliningrad Space Engineering College Faces Changes in Emphasis

93UM0856E Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 18-19

[Interview with Kaliningrad College of Space Machine Building and Technology Director Petr Stepanovich Timoshchenko and deputy for educational work Valentin Vasilyevich Nikolayevets by AVIATSIYA I KOSMONAVTIKA correspondent Lieutenant-Colonel V. Makismovskiy under the rubric "The Future is Being Born Today": "The Next Shift"]

[Text] *All who work in space science are bothered by the question of who will come into this sector tomorrow—and will they come at all? This concern is elicited by the fact that this intellectually capacious form of human activity is today losing its attraction owing to the low pay. Time will pass, and the prestige of the "space" professions will be restored. But won't the potential created over decades be lost? Many people, despite the difficulties, are countering this destructive process by their deeds to keep this from happening. Among them are those who train the cadres for space science.*

Our correspondent Lieutenant-Colonel V. Maksimovskiy visited Kaliningrad near Moscow and met with the director of the College of Space Machine Building and Technology, P. Timoshchenko, and his deputy for educational work V. Nikolayevets.

[V. Maksimovskiy] First a little history, Petr Stepanovich.

[P.S. Timoshchenko] The very first steps in the development and manufacture of ballistic missiles in the postwar years showed that one cannot manage such a complex matter without the purposeful training of specialists. This pertained first and foremost to those who are engaged in production. Skilled people trained in new fields and the chiefs of sections and shops were needed. Chief Designer Sergey Pavlovich Korolev understood that very well. He came forward to the Ministry of Armaments of the USSR with an initiative to create an evening technical school based on Trade School No. 3 at NII-88 [Scientific-Research Institute 88], today the Machine Building TsNII [Central NII]. Then Minister D. Ustinov, taking into account the importance of the task, on 15 March 1947 signed an order to organize a branch of the Moscow Military- Mechanical Technical School with evening training in the city of Kaliningrad.

The first graduation of degreed mechanical technicians, design engineers and technicians for electronic equipment took place four years later. Among them were Georgiy Mikhaylovich Paukov, Viktor Andreyevich

Frolov, later deputy chief designers, along with future chiefs of the famous shop where the spacecraft were and are assembled—Vladimir Ivanovich Zudinov, Grigoriy Markovich Markov and Konstantin Georgiyevich Gorbatenko. Valeriy Vasilyevich Ryumkin, today a famous pilot and cosmonaut of the USSR and twice Hero of the Soviet Union, completed the school in 1958.

[V. Maksimovskiy] So your educational institution has existed as a branch for a long time?

[P.S. Timoshchenko] A day division was organized after the first graduation, and the branch was re-organized into the Kaliningrad Mechanical Technical School. Korolev knew how important it was to maintain a contemporary level of sophistication for the teaching laboratories and constant and direct contacts of the trainees with the enterprises where they would be working, and he did everything necessary. Missiles and test beds on which the designers themselves studied, an engine installation from the V-2, a Schmetterling cruise missile, prototypes of Soviet missiles and much more were transferred there at his orders. These traditions have been preserved. The Soyuz spacecraft, a lunar landing module and a lunar orbital craft have also appeared here with us.

A noteworthy instructional collective has been formed here since the very beginning. N. Vorontsov, V. Postnikov, M. Rusov, M. Belin, M. Zimin, M. Khokhlov, A. Shalashov and others conducted special topics, while A. Khokhlova, A. Pyankov, S. Pomyalov, B. Rukavishnikov and A. Kirimova (and not only they) handled general education. We recalled our veterans warmly when celebrating the 45th anniversary of the school—Hero of the Soviet Union A. Turikov, T. Tikhonova, L. Kabakova, V. Belyayeva, N. Kostyukova, V. Lavrentsov and L. Yudicheva, among others, along with the first directors—S. Malnikov, S. Shcherbakov and Yu. Klimov. They were the ones whose labor created the technical school and its traditions.

Classes were held and are held by specialists from Kaliningrad defense industries, aside from the permanent instructional personnel—from the Energiya NPO [Scientific-Production Association], the Machine Building TsNII, the Chemical Machine Building KB [Design Bureau], the Measurement Engineering NPO and the Kompozit NPO. Technological and pre-diploma practice takes place there for our students—the places they will later be working. Approximately two thirds of our graduates, by the way, have linked their activity with those enterprises, either permanently or for a long time.

[V. Maksimovskiy] Today your "personnel plant" has a different name. Why?

[P.S. Timoshchenko] The high level of instruction and sophistication of the teaching process made it possible for the technical school to become the Kaliningrad College of Space Machine Building and Technology. This is not just a new name, but a new quality as well.

[V. Maksimovskiy] I would like to address these questions to your deputy. Valentin Vasilyevich, do you train a great many specialists?

[V.V. Nikolayevets] We have about a thousand and a half people training here. It is instructive that there have not been fewer candidates in recent years, the passing score on entrance exams is 8—9 for various fields, and we have many of them: industrial engineer for the cold machining of metals, technician for rocket engines or for airframes, programmer, radio technician and control systems instruments, clerk.

There are also fields that have appeared owing to the necessity of working under the new economic conditions and conversion. These are specialists in orthopedic engineering, and in management and marketing.

[V. Maksimovskiy] The latter is clear enough—you can't go into the market without such training. But the former is quite unusual.

[V.V. Nikolayevets] The fact that one of the most important directions in the conversion of the Energiya NPO is the creation of prosthetic and orthotic hardware using advanced space technologies prompted us to engage in the training of technicians for the most varied, complex and modern prostheses. V. Legostayev, Deputy General Designer Yu. Semenova and Frau N. Riedrich—a representative of the German firm of JPOS, which is collaborating with the Energiya NPO in this noble cause—helped us a great deal in "discovering" this new field.

[V. Maksimovskiy] Valentin Vasilyevich, tell us about the problems that you are encountering in training personnel and your views of the future.

[V.V. Nikolayevets] The structural restructuring that our country is undergoing today, in my opinion, has affected the non-production sphere and the defense sectors for which we train specialists first and foremost. There is uncertainty in financing, and in the quantity of them needed. The attempt to make an abrupt transition to a market economy has led to the fact that existing ties have been disrupted. Everyone is "getting by" as best he can, and it must be said not always efficiently. We naturally worry about the fate of our educational institution. The unique laboratory base and skilled instructional collective cannot be lost. That has not happened yet, but the base fields are being displaced by others in some places, often out of opportunistic considerations. But I think this is a temporary matter. New and objectively essential fields will appear, but will those in which we have trained, and are training, the young people be preserved or resurrected? The spiral of the development of society will move out of the shadows and into the light.

[V. Maksimovskiy] I share your optimism. Success to your collective, students and graduates!

Comparison of Features of Space Shuttle and Energiya/Buran Systems

93UM0856F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 20-21

[Article by I. Afanasyev under the rubric "Information for Reflection": "Reusable Spacecraft"]

[Text] *After the completion of the Apollo moon program at the beginning of the 1970s, the U.S. National Aeronautics and Space Administration (NASA) and the Department of Defense launched the design engineering of the Space Shuttle reusable space transport system (MTKS). The decision was made in the USSR to create a transport system for analogous purposes in order to preserve parity, although the conceptual framework for air/space craft had begun to be developed here before the Americans—since the beginning of the 1960s.*

Space Shuttle

Crew. Two astronaut/pilots and up to five flight specialists.

Composition. The Space Shuttle MTKS has an orbital aircraft (OS), an external fuel tank (VTB) and two solid-fuel launch boosters (STU), sometimes called the first stage. The sole non-reusable element of the system is the VTB.

Flight configuration. The three propulsion ZhRDs [liquid-fuel rocket engines] of the OS and STU are ignited from the moment of launch. The MTKS is launched vertically. The spent STUs separate from the VTB and drop into the Atlantic Ocean by parachute. The OS continues flight using its own propulsion ZhRDs, and after the fuel in the VTB is expended the tank separates from the OS and burns up in the atmosphere. The aircraft is brought into orbit using the ZhRD of the orbital maneuvering system (SOM), which operates using storable hypergolic fuel. The MTKS is controlled on the injection section by rolling the propulsion ZhRDs in swivel suspensions and deflecting the STU nozzles in an elastomeric (flexible) bearing. The OS is controlled in orbit by the ZhRDs of the low-thrust rocket control system (RSU), which operates, like the SOM engines, using storable hypergolic fuel and is installed in the nose and in two rear sections. The OS, upon completion of orbital operations, is slowed by the SOM engines, enters the atmosphere and makes an aerodynamic controlled descent, a glide and a horizontal landing with inoperative engines. The RSU are used when leaving orbit and flying in the upper layers of the atmosphere, and the aerodynamic control surfaces enter into operation to the extent of the descent of the OS. The crew pilots the OS on the glide and landing legs.

Design. The wing is a low mounted delta wing with dual sweep on the leading edge, split ailerons on the trailing edge and without any means of mechanization. The fuselage is a semimonocoque design with flat sides. It consists of three parts—the nose holds a two-level airtight cockpit for the crew and a compartment for the electronics gear, the middle has a non-airtight cargo bay (OPN), under which runs the central torsion box of the wing, and in the rear is the compartment for the main engine installation (ODU), the SOM nacelles and the swept tail with a split rudder. The lower portion of the rear tail section has a balancing flap under the fuselage, which plays the role of an air brake along with the rudder during landing. The airframe was constructed principally of aluminum alloys. The doors of the OPN and the fairing of the SOM nacelles are manufactured of graphite-epoxy composite materials (KM); the strength elements of the tail fin are made of boron-aluminum KM, and the seating frame for the main ZhRDs of boron- epoxy KM; the housing of the high-pressure tanks and some of the trunk lines are made of Kevlar-epoxy resin type organic fibers.

Thermal protection of OS is passive, and covers almost the entire surface of the craft. The most heat-stressed locations on the OS—the tips of the fuselage and the wing—are covered with reinforced carbon-carbon type KM, followed by plates of silicon dioxide with a boron-silicate coating with heat-resistant additives that are black in color protecting the lower surfaces of the fuselage and the wing, as well as its tips and trailing edge. White plates of silicon dioxide fibers with a boron-silicate coating are installed on the upper surfaces of the wing and fuselage, the tail fin and the SOM nacelles. The least heat-stressed locations—the OPN doors, upper surface of the wing and sides of the fuselage and SOM nacelles—are protected with mats of nylon fiber covered with an organic silicon resin.

Engine installations. The main engine installation consists of three SSME oxygen-hydrogen propulsion ZhRDs from the firm of Rocketdyne, with a thrust of 170 tones of force each on Earth or 213 tons in a vacuum. The engines have a self-contained configuration (both components enter the combustion chamber in gaseous form), with the reheating of spent turbogas in high-pressure combustion chambers, installed on the OS and fed from the VTB. The two solid-fuel launch boosters from the firm of Morton-Thiokol mounted along the sides of the VTB have a thrust of 1,203 tons of force at sea level.

The power plant of the OS consists of three batteries of hydrogen-oxygen fuel elements and three hydrazine auxiliary power plants used to steer the main ZhRDs, as well as to control the aerodynamic surfaces and the landing gear.

Status. The Space Shuttle MTKS had made 53 flights as of January 1993. Six OS were built—the Enterprise (employed as an analogue of the OS for horizontal flight testing), the Columbia, the Challenger (lost in the catastrophe of January 1986), the Atlantis, the Discovery and the Endeavour. The system continues to be in service.

Additional information. The existing configuration of the MTKS was chosen in 1974. The flight testing started in April of 1981.

The MTKS is currently employed for deliveries to space, supporting astronauts in orbit and returning especially valuable payloads to Earth, but the Department of

Defense had decided by the end of 1992 to refrain from the use of the MTKS to put military payloads into orbit, and to use the non-reusable launch vehicles of the Titan family for this purpose.

Energiya/Buran

Crew. Two to four cosmonaut/pilots and up to six flight specialists.

Composition. The Energiya/Buran MTKS includes the Energiya launch vehicle (four Zenit-1 launch boosters and a central second-stage unit), which is able to put various payloads and the Buran orbital vessel (OK) into orbit. The OK and the launch boosters are the reusable elements of the system.

Flight configuration. At the moment of launch the MTKS includes the four RD-0120 oxygen-hydrogen engines of the central unit and the four RD-170 oxygen-kerosene engines of the boosters. Launch is vertical. The boosters separate from the central unit after finishing their operation, make a parachute descent in the atmosphere and land. The central unit ceases operation before reaching the nominal orbit, separates from the OK and is destroyed on entering the dense layers of the atmosphere. The OK is brought up to orbit using two oxygen-kerosene ZhRDs of the SOM system. The MTKS is controlled during this ascent stage by steering the combustion chambers of the ZhRDs in the central unit and the boosters on their bearing suspensions. Low-thrust oxygen- kerosene ZhRDs mounted in the nose and two in the rear RSU units control the OK in orbit. After the completion of orbital operations, the SOM engine issues a braking impulse, and the OK enters the atmosphere, makes an aerodynamic controlled descent, glides and make a horizontal landing with non-operating engines. The RSUs are used when leaving orbit and in the upper layers of the atmosphere, with the aerodynamic control surfaces coming into action to the extent of the descent of the OK. The OK can be controlled on the glide and landing legs either by the crew or automatically.

Design of the OK. The Buran is in principle analogous to the OS of the Space Shuttle by and large, but its wing is shifted forward somewhat. The tail section of the fuselage, aside from the rudder and flap under the fuselage, has the SOM engine installation, RSU units and a pod with the braking parachute.

Thermal protection of the OK is passive and plated. The tips of the fuselage and wing are covered with a carbon-carbon type reinforced KM, with the less heat-stressed places having plates of sintered quartz fiber with a protective coating. The thermal protection of the Buran OK, as opposed to the American craft, is "all-weather"—it can withstand rain and hail.

Engine installations. The principal ZhRDs of the launch vehicle and the ship are executed in a self-contained configuration (hydrogen comes into the combustion chamber in gaseous form, and the oxygen in liquid form) with the reheating of spent turbogas in the combustion chambers under high pressure. The RD-170 engines have a thrust of 740 tonnes of force each, the RD-0120s 156 tonnes each (205 in a vacuum) and the SOM ZhRDs 8,500 tonnes in a vacuum.

The power plant of the Buran OK is analogous to that of the Space Shuttle OS.

Status. The Energiya launch vehicle has made two flights—15 May 1987 with a Skif-DM (Polyus) module as the payload, and 15 November 1988 with the Buran OK without cosmonauts. The OK No. 1 had been mothballed by the start of 1993, with the OK No. 2 prepared for orbital flight; the manufacture of OK No. 3 has been curtailed.

Additional information. The decree on the development of the Energiya/Buran MTKS came out in February 1976 after the cancellation of the N1-L3 program. The manufacture of five Buran OKs had been proposed. The MTKS was to meet the country's needs for the placement into orbit of medium and heavy payloads for civilian and military purposes, with the return of some of them to Earth.

A special version of the VM-T bomber, which provided for the separate transport of the launch vehicle and the OK on an external hanger over the aircraft fuselage, was created in order to transport the larger elements of the system from the manufacturing plant to the engineering positions. The An-225 Mriya heavy-lift transport aircraft was later created for these same purposes.

Smaller models of the OK (the BOR-4 and BOR-5) launched using the Kosmos launch vehicle were used to try out the aerodynamics and thermal protection of the craft in the range of high hypersonic speeds.

Flight testing of the Energiya/Buran has been halted, owing to the cutbacks in appropriations and the loss of interest in the program on the part of the Ministry of Defense. A non-piloted flight of Buran OK No. 2 is being proposed for 1993, with the subsequent mothballing of all of the MTKSs until such time as spheres for its efficient utilization are found.

Dimensional, Mass and Flight Characteristics of MTKS

Parameters	Space Shuttle	Energiya/Buran
Dimensions, meters:		
height of MTKS at launch	56	58.77
maximum cross section	23.8	17.9 (launch vehicle)
length of OS (OK)	37.3	36.37
height of OS (OK)	17.3	16.45
wingspan of OS (OK)	23.8	23.9
length of VTB (central unit)	47	58.77
diameter of VTB (central unit)	8.9	7.75
length of STU (booster)	45.5	39.67
diameter of STU body (booster)	3.7	3.9
Mass, tonnes:		
overall launch of MTKS	2,020	2,400
launch of OS (OK)	114	105
payload to low near-Earth orbit	29.5	30
payload, returnable to Earth	14.5	20
Flight characteristics:		
launch thrust of MTKS engine installation, tonnes of force	2,920	3,600
height of near-Earth orbit, km	200—1,200	200—1,200
range of lateral maneuver in descent in atmosphere, km	up to 2,000	up to 2,000

Table of Russian Spacecraft Launches in 1992

93UM0856G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 22-23

[Material assembled by Colonel S. Vladimirov under the rubric "By Reader Request": "Table of Launches of Domestic Spacecraft in 1992"]

[Text]

Date of launch	Launch cosmodrome	Name of craft	Name of launch vehicle	Initial parameters of orbit				Term of ballistic existence, years (or date operation ceased)
				Orbital period, minutes	Inclination, degrees	Maximum altitude, km	Minimum altitude, km	
21 January	Plesetsk	Kosmos- 2175	Soyuz	89.6	67.1	373.3	173.4	20 Mar 92
24 January	Plesetsk	Kosmos-2176	Molniya	11 h 49.5 m	62.8	39,342.0	613.0	16.5
25 January	Baykonur	Progress M- 11	Soyuz	88.5	51.7	244.0	190.0	13 Mar 92
30 January	Baykonur	Kosmos-2177	Proton	11 h 16.1 m	64.9	19,169.0	19,130.0	1 million
30 January	Baykonur	Kosmos-2178	Proton	11 h 16.1 m	64.9	19,169.0	19,130.0	1 million
30 January	Baykonur	Kosmos-2179	Proton	11 h 16.1 m	64.9	19,169.0	19,130.0	1 million
18 February	Plesetsk	Kosmos- 2180	Kosmos	104.9	82.9	1,028.2	980.0	1,200
4 March	Plesetsk	Molniya-1	Molniya	11 h 42 m	62.9	38,998.0	629.0	16.5
10 March	Plesetsk	Kosmos- 2181	Kosmos	105.0	82.9	1,027.0	994.0	1,200
17 March	Baykonur	Soyuz TM- 14	Soyuz	88.78	51.7	260.3	198.9	10 Aug 92
1 April	Plesetsk	Kosmos- 2182	Soyuz	89.5	67.2	350.0	179.0	30 May 92

Date of launch	Launch cosmodrome	Name of craft	Name of launch vehicle	Initial parameters of orbit				Term of ballistic existence, years (or date operation ceased)
				Orbital period, minutes	Inclination, degrees	Maximum altitude, km	Minimum altitude, km	
2 April	Baykonur	Gorizont	Proton	23 h 48 m	1.5	35,685.0	35,570.0	1 million
8 April	Baykonur	Kosmos- 2183	Soyuz	89.0	64.9	288.8	190.4	16 Feb 93
15 April	Plesetsk	Kosmos- 2184	Kosmos	105.0	82.9	1,027.0	987.0	1,200
20 April	Baykonur	Progress M-12	Soyuz	88.41	51.7	228.8	192.5	28 Jun 92
29 April	Plesetsk	Resurs- F	Soyuz	88.82	82.1	270.2	197.4	29 May 92
29 April	Baykonur	Kosmos- 2185	Soyuz	89.4	70.0	313.9	205.5	12 Jun 92
28 May	Plesetsk	Kosmos- 2186	Soyuz	89.7	62.9	350.0	195.0	24 Jul 92
3 June	Plesetsk	Kosmos- 2187	Kosmos	115.3	74.01	1,506.07	1,443.61	10,000
3 June	Plesetsk	Kosmos- 2188	Kosmos	115.3	74.01	1,506.07	1,443.61	10,000
3 June	Plesetsk	Kosmos- 2189	Kosmos	115.3	74.01	1,506.07	1,443.61	8 Sep 92
3 June	Plesetsk	Kosmos- 2190	Kosmos	115.3	74.01	1,506.07	1,443.61	10,000
3 June	Plesetsk	Kosmos- 2191	Kosmos	115.3	74.01	1,506.07	1,443.61	10,000
3 June	Plesetsk	Kosmos- 2192	Kosmos	115.3	74.01	1,506.07	1,443.61	10,000
3 June	Plesetsk	Kosmos- 2193	Kosmos	115.3	74.01	1,506.07	1,443.61	10,000
3 June	Plesetsk	Kosmos- 2194	Kosmos	115.3	74.01	1,506.07	1,443.61	10,000
23 June	Plesetsk	Resurs- F	Soyuz	88.7	82.3	256.9	190.1	9 Jul 92
30 June	Baykonur	Progress M-13	Soyuz	88.5	51.6	243.7	189.4	24 Jul 92
2 July	Plesetsk	Kosmos- 2195	Kosmos	104.8	82.9	1,023.3	974.5	1,200
8 July	Plesetsk	Kosmos- 2196	Molniya	707.1	62.8	39,235.0	608.0	16.5
13 July	Plesetsk	Kosmos- 2197	Tsiklon	114.0	82.6	1,440.2	1,399.7	9,500
13 July	Plesetsk	Kosmos- 2198	Tsiklon	114.0	82.6	1,441.7	1,408.7	9,500
13 July	Plesetsk	Kosmos- 2199	Tsiklon	114.3	82.6	1,442.4	1,421.7	9,500
13 July	Plesetsk	Kosmos- 2200	Tsiklon	114.1	82.6	1,439.9	1,411.9	9,500
13 July	Plesetsk	Kosmos- 2201	Tsiklon	114.3	82.6	1,442.4	1,418.9	9,500
13 July	Plesetsk	Kosmos- 2202	Tsiklon	114.3	82.6	1,442.4	1,421.7	9,500
15 July	Baykonur	Gorizont	Proton	24 h 00 m	1.4	36,650.0	36,484.0	1 million
24 July	Plesetsk	Kosmos- 2203	Soyuz	89.5	62.8	334.1	198.0	22 Sep 92
27 July	Baykonur	Soyuz TM- 15	Soyuz	88.6	51.6	233.0	200.0	1 Feb 93
30 July	Baykonur	Kosmos-2204	Proton	11 h 16 m	64.8	19,141		1 million
30 July	Baykonur	Kosmos-2205	Proton	11 h 16 m	64.8	19,141		1 million
30 July	Baykonur	Kosmos-2206	Proton	11 h 16 m	64.8	19,141		1 million
30 July	Plesetsk	Kosmos- 2207	Soyuz	88.7	82.3	264.0	196.0	13 Aug 92
6 August	Plesetsk	Molniya-1	Molniya	12 h 17 m	62.8	40,693.0	636.0	16.5
12 August	Plesetsk	Kosmos- 2208	Kosmos	100.0	74.1	826.0	789.6	120
16 August	Baykonur	Progress M-14	Soyuz	88.6	51.6	251.0	191.0	22 Oct 92
19 August	Plesetsk	Resurs- F	Soyuz	88.7	82.6	258.0	193.0	4 Sep 92
10 September	Baykonur	Kosmos-2209	Proton	24 h 03 m	1.3	35,935		1 million
22 September	Plesetsk	Kosmos- 2210	Soyuz	89.7	67.2	380.0	173.0	20 Nov 92
8 October	Plesetsk	Foton	Soyuz	90.3	62.8	382.0	227.6	24 Oct 92

Date of launch	Launch cosmodrome	Name of craft	Name of launch vehicle	Initial parameters of orbit				Term of ballistic existence, years (or date operation ceased)
				Orbital period, minutes	Inclination, degrees	Maximum altitude, km	Minimum altitude, km	
14 October	Plesetsk	Molniya-3	Molniya	12 h 17 m	62.8	40,854.0	461.1	16.5
20 October	Plesetsk	Kosmos- 2211	Tsiklon	113.9	82.6	1,440.3	1,402.3	7 Dec 92
20 October	Plesetsk	Kosmos- 2212	Tsiklon	114.1	82.6	1,441.5	1,410.1	9,500
20 October	Plesetsk	Kosmos- 2213	Tsiklon	114.1	82.6	1,442.3	1,414.3	9,500
20 October	Plesetsk	Kosmos- 2214	Tsiklon	114.1	82.6	1,440.9	1,413.5	9,500
20 October	Plesetsk	Kosmos- 2215	Tsiklon	114.2	82.6	1,441.9	1,418.9	9,500
20 October	Plesetsk	Kosmos- 2216	Tsiklon	114.3	82.6	1,448.8	1,416.0	9,500
21 October	Plesetsk	Kosmos-2217	Molniya	11 h 48 m	62.8	39,400.0	600.0	16.5
27 October	Baykonur	Progress M-15	Soyuz	88.5	51.6	233.0	194.0	7 Feb 93
29 October	Baykonur	Kosmos- 2218	Kosmos	105.0	82.9	1,028.0	989.0	1,200
30 October	Baykonur	Ekran-M	Proton	23 h 48 m	1.44	35,661.0	35,576.0	1 million
16 November	Plesetsk	Resurs- F	Soyuz	88.8	82.6	269.6	194.3	22 Nov 92
17 November	Baykonur	Kosmos- 2219	Zenit	102.0	71.0	880.9	851.9	120
20 November	Plesetsk	Kosmos- 2220	Soyuz	89.6	67.2	368.0	178.0	18 Jan 93
24 November	Plesetsk	Kosmos- 2221	Tsiklon	97.8	82.6	678.0	651.0	60
25 November	Plesetsk	Kosmos-2222	Molniya	11 h 48 m	62.8	39,340.0	615.0	16.5
27 November	Baykonur	Gorizont	Proton	24 h 32 m	1.4	36,518.1	36,462.8	1 million
2 December	Plesetsk	Molniya-3	Molniya	11 h 41 m	62.5	39,103.0	466.0	16.5
9 December	Baykonur	Kosmos- 2223	Soyuz	89.1	64.7	299.9	188.8	—
17 December	Baykonur	Kosmos-2224	Proton	24 h 00 m	2.3	35,884.0	35,837.0	1 million
22 December	Baykonur	Kosmos- 2225	Soyuz	89.4	64.9	336.6	178.5	18 Feb 93
22 December	Plesetsk	Kosmos- 2226	Tsiklon	116.0	73.7	1,538.0	1,498.0	9,500
25 December	Baykonur	Kosmos- 2227	Zenit	102.0	71.0	880.0	852.0	120
25 December	Plesetsk	Kosmos- 2228	Tsiklon	97.8	82.5	681.0	646.0	60
29 December	Plesetsk	Kosmos- 2229	Soyuz	90.5	62.8	396.8	226.0	10 Jan 93

Notes

Progress M-11, -12, -13, -14, -15—automatic freight vessels. Purpose of launch was to deliver consumables and various freight to Mir orbital station.

Kosmos—name of series of artificial Earth satellites that have been launched regularly from the country's cosmodromes (starting on 16 March 1962).

Their tasks include:

—study of the concentration of charged particles in the ionosphere for the purpose of researching the propagation of radio waves, corpuscular streams and particles of small energies, the energy composition of the radiation belts of the Earth to assess the radiation hazard in prolonged space flights, processes of adaptation and weightlessness, the primary composition of cosmic rays and variations in their intensity, the magnetic field of the Earth, the shortwave emissions of the sun and other heavenly bodies, the upper layers of the atmosphere and the effects of meteoric matter on structural elements of space objects;

—research on space materials science, determining the influence of factors of space flight on living organisms, the receipt of efficient information on the Earth's natural resources in the interests of various sectors of the national economy and international collaboration;

—trying out elements and apparatus of space navigational systems (being created for the purpose of determining the locations of aircraft and maritime vessels), experimental apparatus intended for the system for determining the location of ships and aircraft that are lost, experimental apparatus for the relay of telegraph and telephone information, equipment, units and elements of the structural elements of satellites in various flight modes, including joint;

—receipt of efficient information and continuation of run-through of new types of information-measurement apparatus and methods of remote

research of the Earth's surface, atmosphere and oceans in the interests of various sectors of the national economy, science and international collaboration.

Molniya-1—a communications satellite intended to support the operations of long-range telephone and telegraph radio communications systems, as well as the transmission of programs from Central Television to points on the Orbita network.

Soyuz TM-14, -15—improved spacecraft intended for the delivery of crews to multipurpose manned systems of a modular type. New systems for approach and docking, radio communications and emergency rescue, as well as a new combined engine and parachute system, have been installed on the craft.

Gorizont—communications satellite to support around-the- clock long-range telephone and telegraph radio communications and the transmission of television programs to stations of the Orbita and Moskva networks, as well as for use in the Intersputnik international satellite communications system.

Resurs-F—a satellite intended for the performance of multiple-zone and spectral-zone photographing in various scales for the purpose of researching the Earth's natural resources in the interests of various sectors of the national economy and accomplishing tasks of ecology and international collaboration.

Foton—a satellite intended for researching space materials science. The flight program envisaged the conduct of experiments to obtain crystals of proteins and semiconductor materials with improved properties under the conditions of microgravitation, as well as to try out technologies for their experimental industrial production. Scientific-research apparatus was also installed on the satellite for the National Center for Space Research of France.

Molniya-3—a communications satellite to support the operations of long-range telegraph and telephone radio communications, the transmission of the programs of Central Television to points on the Orbita network and international collaboration.

Ekran—a satellite for television broadcasting with on-board relay gear supporting the transmission of the programs of Central Television to shared receiving devices in the decimeter waveband.

There were 75 spacecraft in all launched into orbit in 1992, including the Kosmos 2177—Kosmos 2179, Kosmos 2187—Kosmos 2194, Kosmos 2197—Kosmos 2202, Kosmos 2204—Kosmos 2206 and Kosmos 2211—Kosmos 2216 using the same launch vehicle.

Helicopter Regiment Commander Details Relocation Problems

93UM0856H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) p 29

[Article by Military Pilot 1st Class Colonel A. Denishchev under the rubric "For High Combat Readiness": "A Restructuring in the Combat Ranks..."]

[Text] ... *was conducted by the aviators of the detached helicopter regiment commanded by Military Pilot 1st Class Colonel A. Denishchev, which encountered a host of difficulties when withdrawing from the ZGV [Western Group of Forces] and arriving in the Motherland. How they were able to set up combat training in a new location thanks to this "restructuring" is related by the commander.*

People say that one move is worth two fires. And not for nothing—our own experience convinced us of that. We had just sent off the first echelons with the technical matériel to Azerbaijan, to the new base location, when we were suddenly removed from there and assigned to a different base airfield. We rushed to re-address our "household," not very likely with such haste. It was good that we got back at least some of the freight.

We had barely been able to recover from this scenario when there came the next—we received, instead of our own (almost completely new) helicopters, some that had "served out their lifetimes" from army aviation units that were still on the territory of Germany. It then became clear that the service lives of many of these combat craft would be sufficient just for the ferry flight to the Motherland. The aviation specialists under the supervision of my deputy for IAS [aviation engineering service], Lieutenant-Colonel V. Petkevich, had to sweat their guts out, as they say, to prepare the equipment for rebasing in a timely and quality manner.

But the main test awaited us on the ground, it turned out, and not in the air. And it started with the fact that there was not even anywhere to put the helicopters at the airfield where the regiment went. All of the suitable sites were occupied with aircraft from the local air club. There was nothing else to do—we had to take axes and shovels to set up new hardstands. We handled that task well enough.

We are still toiling with housing for the personnel. While the bachelors could still be put into barracks somehow, setting up the families was a very complicated matter—we couldn't even find any suitable rooms. We had to rent living space within a radius of 30 kilometers from the airfield. I, as commander, could not count on the rapid assembly of the personnel.

The energetic participation of the local administration and its head, V. Rudnitskiy, in solving our problems is easing everyday tensions. A team of construction workers repaired the office accommodations at the airfield under his direction, the head of one of the city's

industrial enterprises has leased us a dormitory and the Zodchiy cooperative has built a barracks and teaching wing. The erection of the air compound is proceeding at a very slow rate nonetheless. Somebody, after all, is to blame that the construction started eight months late. Exactly who? Perhaps they know in Moscow?

But housing is housing, and the regiment must be combat-ready. No one has taken that task from us. The fliers, then, having completed their "earthmoving operations," have finally sat down at their desks and set about studying a flight region new to them without delay, and successfully passed the corresponding performance evaluations. I would like to note the efficiency with which the regimental senior navigator, Lieutenant-Colonel V. Zatinshchikov, developed, coordinated and obtained approval at the MVO [Moscow Military District] Air Forces headquarters for flight performance instructions—a document without which there could be no discussion whatsoever of flight training.

It must be admitted that the rhythm of flight training was disrupted at first owing to the constant interruptions in the supply of fuel and spare parts. We had to plan reduced flight shifts, but fortunately the proficiency levels of most of the pilots did not force us to accelerate their further training. The lag in the fulfillment of the norms for flying time at night in bad weather conditions was of concern, it is true, since a number of restrictions were imposed on the flights of our aviation after the unification of Germany. The flight commanders made up a detailed schedule for the restoration of lost skills by types of flight training, and set an annual threshold for each crew. This lag was able to be eliminated, to the credit of the entire collective. The work was organized best of all in the squadron of Lieutenant-Colonel N. Pyrin, who had many years of service in the DVO [Far East Military District] and is a "double Afghan." Most of his subordinates also completed the harsh schooling of Afghanistan.

I can assert with all confidence that virtually all of the crews are ready to perform the most complex combat missions today. Confirmation of this are the results of performance evaluations of combat readiness of the regiment by representatives of the Air Forces staff of the district. The personnel demonstrated good theoretical knowledge and high professional proficiency during them. The group of aviators headed by Major L. Kokoulin in particular, making use of the results of aerial reconnaissance, determined the optimal composition and most effective means of operation for the helicopter fliers to execute a fire strike from the air. The pilots in the flight of Major M. Pukhov handled the task of identification and target designation in excellent fashion; they clarified and transmitted in timely fashion the coordinates of "enemy" targets to the leaders of the groups—Lieutenant-Colonels A. Zittser and S. Kostikov. Their subordinates operated in masterly fashion, destroying ground targets on the first pass. The officers of the flight supervision group, who controlled them reliably on all sorties, also deserve no small amount of credit for the successful fulfillment of the assignments by the crews.

The results of the performance evaluations were doubly pleasing since we had to take part in them with a reduced complement. About a third of the officers and warrant officers, after all, signed requests for discharge from the armed forces or transfer to other service locations after the return to the Motherland. The departure of the younger ones, who were only yesterday filled with the hope of professional growth, is especially regrettable. The highly rated specialists and pilots/weapons officers Senior Lieutenants D. Pyshchev and V. Sychev have thus parted with aviation. And young officers such as them were worth 15 people. There is no need to relate the feelings that arose in parting with them.

Aviators who have decided to link their fate with service in the Russian Air Forces have meanwhile been coming to our regiment from the former republics since the collapse of the USSR and the start of the migration of servicemen. Senior Lieutenants S. Klichko and S. Abdurakhmanov, who came from Uzbekistan, were comparatively recently assigned to the post of flight technicians. A good spot is not long empty, as they say.

It is important that the newcomers be helped to gain confidence in themselves and regain their former optimism. The work of my deputy for personnel work, Lieutenant-Colonel V. Malashkin, should be singled out in this regard. Our collective is gaining army strength and cohesion again largely thanks to him. That is pleasing. I can thus state firmly that the regiment has successfully carried out the essential "restructuring in the combat ranks."

Unusual Case of G-Force Pickup Countered Successfully in Flight

93UM0856I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 30-31

[Article by Candidate of Technical Sciences Colonel Ye. Vostrikov under the rubric "Flight Safety: Special Case": "Pickup"]

[Text] An Su-17MD fighter/bomber taxied out to the runway. Major A. Koval, military pilot 1st class, was to make a flight in the aerobatic area.

Takeoff, climb and arrival at the zone. Out of a steep climb, the pilot went into a wingover and created an angle of attack when pulling out of the descent that was close to the maximum allowable so as to come out with the minimal loss of altitude. He felt increasing G-forces, however, at an altitude of 2,800 meters at a speed of 800 km/hr and an angle of dive of 30° with a virtually immobile control stick. He looked at his instruments—the indicator for the angles of attack was off the scale.

He needed only a few seconds to assess the situation and make the correct decision. Through the vigorous pushing of the stick away from himself, he brought the aircraft out of the area of supercritical angles of attack and

thereby averted entry into a stall mode. He reported what had happened to the flight operations supervisor, and on command curtailed his fulfillment of the assignment and returned to the airfield.

The aircraft had still not landed and specialists had already begun to discuss the possible causes for what had happened. Some suggested that the aircraft could have gotten into wake turbulence. Others felt that a G-force pickup had occurred, which was possible in this flight mode with vigorous piloting and the pulling of the stick toward oneself at a rapid rate. Reference was made to instructions. The opinion was expressed that an unsanctioned triggering of an SAU [automatic control system] actuator had occurred. The final answer, however, should have been provided by the "black box"—the on-board recording device (BUR).

The section of the flight where the precondition to a flight accident arose (Fig. 1, AB) was carefully analyzed in the decoding of the entries. The aircraft, at an altitude of 5,100 meters at a speed of 590 km/hr, went into the wingover (Fig. 1, 1-1) with the creation of a roll angle of 180° and the pulling back of the stick. The aircraft, in an upside-down position, began to curve in trajectory energetically through the large angles of attack. In a near-vertical dive (Fig. 1, B) the angle of attack increased to the maximum allowable value in operation (Fig. 1, C) owing to the movement of the stick for pitch. It later increased to a critical value (Fig. 1, K) with a virtually immobile stick. The aircraft was in the area of supercritical angles of attack for about three seconds, and only thanks to the pilot's vigorous pushing of the stick from 15° to 8° did he get out of it.

That is the general picture of the dynamic of the aircraft's behavior on the section of the flight under consideration, but the causes were still not clear. The specialists carefully checked out all the variations. Analogous situations were considered to confirm the first variation—getting into wake turbulence. The typical traits of that are arbitrary changes in the normal G-forces, and chaotic changes in G-forces and speed within small limits of about their average values, conditioned by the effects of disturbances from the wake turbulence. A comparison of the recordings (Figs. 1 and 2) made it possible to be convinced that the overshoot of the angle of attack was not caused by wake turbulence.

As for the second version—a manifestation of G-force pickup—the data from the recording gear testified that there had been no vigorous movements of the stick for pitch before the arbitrary increases in the values of the angle of attack. This version was thus also invalid.

The third version—violations of the functioning of an SAU actuator, which could have deflected the stabilizer into a non-standard position and created angles of attack greater than those allowable—was rejected after the decoding of the entries for the movement of the stick for pitch X_p and the angle of deflection of the stabilizer φ_{st}, as well as a comparison of their values with standard

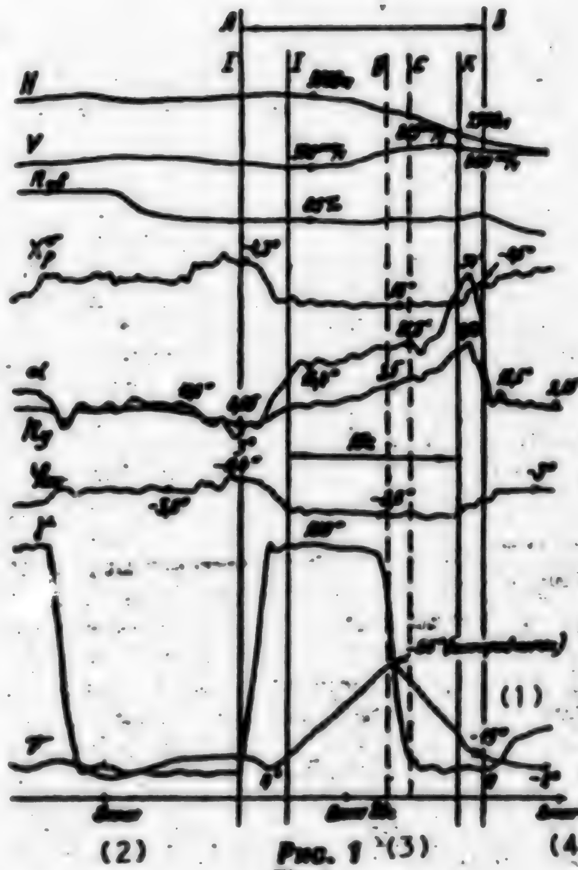


Fig. 1.

Key:
1. dive
2. 8 minutes
3. 8 minutes 20 seconds
4. 8 minutes 40 seconds

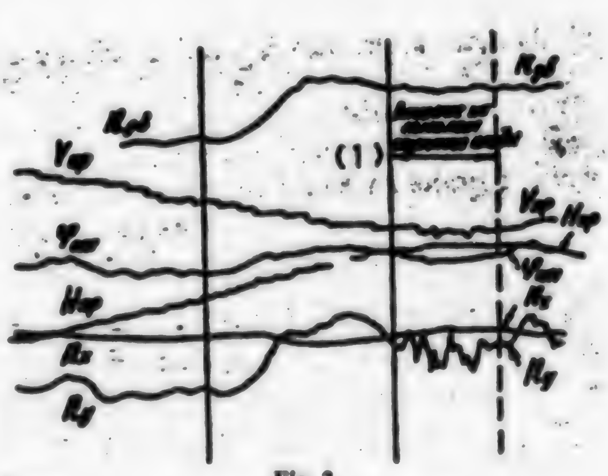


Fig. 2.

Key:
1. Effects of wake turbulence on aircraft

ones (Figs. 3, 1 and 2). Analysis showed that the control system was functioning normally, and the stabilizer had not been deflected by the SAU actuator mechanism.

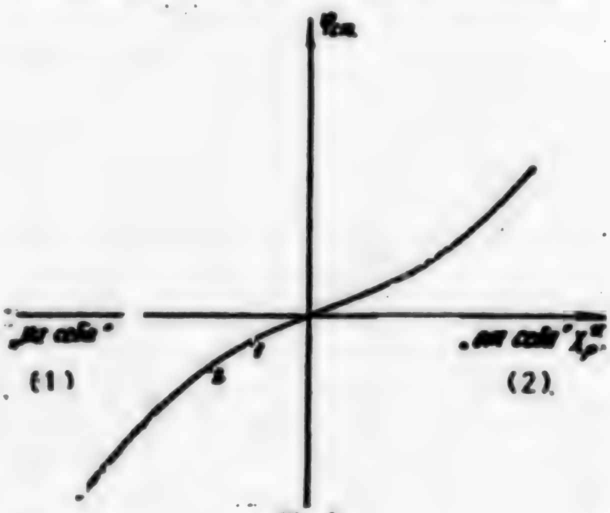


Fig. 3.

Key:
1. pull stick
2. push stick

Continuing the research, and in particular analyzing the materials of flight testing, specialists established that such a phenomenon had taken place, but at angles of attack greater than allowable ones. They were within the permissible angles on this aircraft, but close to the maximums. What was the essence of this feature?

It can be observed only at Mach values less than the unit value, and is characteristic of aircraft with a swept wing at large angles of attack, when the linear dependence between the coefficients of the longitudinal moment M_z and the lift force Cy is disrupted (Fig. 4). These phenomena, as flight practices show, are manifested most often at Mach values of 0.7—0.9. The aircraft was at Mach 0.76 in this instance. An involuntary pull-up is an outward manifestation of instability in G forces n_y. The cause of this is an impermissibly strong displacement forward of the center of pressure as a consequence of the development of a tip stall in the flow on the wing, as well as interference between the fuselage, wing and empennage. A tip stall on a swept wing causes a redistribution of loads across its span, which leads to an increase in the lift factor of the blade-root cross- sections and a decrease at the wingtips. The pressure center of the wing and the aerodynamic focus are thus displaced forward. The latter causes changes in the coefficient M_z^{Cy} and the appearance of neutrality and instability in the aircraft. A number of design refinements have been made to eliminate them, making it possible to delay the development of tip stall in the flow. These include the installation of special fences on the wing, the geometric and aerodynamic twisting of the wing, the use of leading-edge flaps, deflectable tips etc.

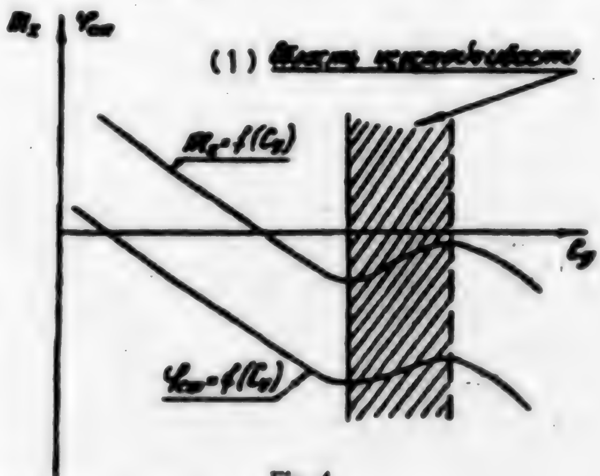


Fig. 4.

Key:
1. Region of instability

These measures made it possible to obtain satisfactory characteristics for longitudinal stability and controllability up to the maximum angles of attack in operation. This case, however, which has received the name of "stall pickup" in the technical literature, has called into question the completeness of the research that was conducted in the past, and has brought about the necessity of additional work to evaluate the behavior of the aircraft at maximum angles of attack.

Local G-force instability is an undesirable phenomenon in the operational realm of flight modes. It creates preconditions for unintentional losses of speed, transition to supercritical angles of attack and the entry of the aircraft into intolerably large G-forces. Enhanced attention of the pilot and great precision in actions with the control surfaces in piloting are required in this case. It should be remembered that countering the arbitrary fluctuations of the aircraft using deflections of the ailerons or control surfaces when getting into a "pickup" mode and stall not only do not have any impact, but can also lead to a spin. It is thus essential, when reaching angles of attack greater than those allowable, to leave the ailerons in neutral position and not to permit any slip using the rudder. Only the vigorous pushing of the stick away from oneself can bring the aircraft out of the critical zone. These were indeed the actions that were recorded by the on-board recording gear in this instance. This confirmed the good training of the pilot and his profound knowledge of the practical aerodynamics of the aircraft.

Air Forces Engineering Academy Chief on Future Prospects, Plans

93UM0856J Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 31-32

[Article by Chief of the Air Forces Engineering Academy Candidate of Military Sciences and Professor Colonel-General of Aviation V. Kovalenok under the rubric "Military Reform and Higher Educational Institutions": "Preserve and Augment Pedagogical-Science Potential"]

[Text] *A practical-science conference with the participation of representatives of a number of directorates of the central apparatus of the Ministry of Defense and the higher educational institutions of all branches of the armed forces of the Russian Federation was held in October of 1992 at the Air Forces Engineering Academy imeni Professor N.Ye. Zhukovskiy. Dissatisfaction with the current situation in the system of higher military education was distinctly heard in the papers and presentations. The contribution of higher educational science to resolving defense tasks in particular is being hindered by the sharp reduction in appropriations for its development and the lack of a streamlined mechanism for mutual relations between state budgetary and economically accountable structures, as well as the principles of financial and economic activity in the army and navy under conditions of cutbacks in the size of the armed forces and the transition to a market economy. The chief of the Air Forces Engineering Academy, Candidate of Military Sciences and Professor Colonel-General of Aviation V. Kovalenok, shares his thoughts on this problem.*

The results of the conference confirmed yet again that the military academies and leading higher educational institutions of the branches of the Armed Forces today should be considered centers supporting the unity of the educational and scientific processes in the training of specialists for the 21st century. Meanwhile, the rapid outflow of young and promising staffers and experienced instructors to commercial structures is taking place, and the aspiration of the trained cadres to serve only until they reach pension age is progressing, owing to their limited independence in creating and reforming the scientific- educational subunits, training and certifying pedagogical cadres and awarding them military ranks, as well as the lack of a flexible mechanism of material incentives for the labor of military scholars.

The leadership of the Air Forces is taking certain steps in order to eliminate these causes. For example, specialists at a number of scientific-research institutions, in conjunction with representatives of our academy, are currently formulating a conceptual model for a unified system of training for engineering and scientific-pedagogical cadres for the Air Forces. A leading place in that is relegated to the development of new educational programs and progressive training technologies.

The academy, from the standpoint of the new requirements, is also engaged in the training of aviation engineers in seventeen fields and nine specialties, as well as doctors and candidates of sciences in doctoral studies, campus or off-campus graduate study and through dissertations. A rise in the qualifications of attendees in academic courses of study has been organized. Such intensive training of military cadres in many fields poses strict demands for the level of pedagogical mastery and scientific maturity of the professor and instructor personnel. I can assert with full confidence that the scientific-pedagogical potential of the academy (there are 96 doctors and more than 500 candidates of sciences today) by and large meets the behest of the times. And that is no accident, since we devote constant attention to augmenting it. The capacity of campus graduate studies alone is 235 places today. Some 199 doctors and 2,512 candidates of sciences have been trained since the time the academy was created. More than 400 people are working on their dissertations today, including 36 at the doctoral level. The subject matter of scientific works is aimed first and foremost at raising the combat readiness and quality of aviation engineering support for the combat operations of the Air Forces with a regard for trends in the development of the means of armed struggle, flight safety, reliability and combat survivability, reducing the detectability of aircraft and creating more effective weaponry, piloting, navigational and sighting systems and means of aerial reconnaissance and electronic warfare, including those founded on new principles and phenomena of physics.

I would like to emphasize that improving the systems for training pedagogues and scholars at our academy is not an end in itself. The work in this area, after all, is oriented toward the end result—the high professionalism of the graduates and the pursuit of basic scientific research. The amount of that, by the way, has increased by one-and-a-half times compared to 1989.

The solution of the problem of preserving and supplementing the scientific potential of the academy, at the same time, entails certain difficulties—as it does, by the way, at other higher educational institutions as well. This pertains first and foremost to the realization of the Statute on the Completion of Active Military Service, especially by highly skilled scholars. Statistics show that a pedagogue reaches the pinnacle of academic maturity at 45—50 years of age. And that is just the age when he is subject to discharge into the reserves. I cite as an example the fact that 25 (!) doctors of sciences who had served out the stipulated term left the walls of the academy in 1987 and 1988 alone. We must urgently seek out reserves and make up for the losses. We have been left standing this time. If the cutbacks in the army continue to proceed by treating everyone alike in the future as well, however, there soon will not be a single doctor of sciences left at the higher educational institutions. I think there is no need to say where that could lead.

A maximum age for military service of 60 years for doctors of sciences and 55 for candidates must be established in this regard, in the opinion of participants in the conference, once and for all getting rid of the willful approach to the procedure for discharging them,

allowing the academic councils of the higher educational institutions to determine independently the term of service of each leading scholar individually and shifting the positions of the professor and instructor personnel from the category of military to civilian and vice versa.

Much could be resolved at the local level using internal resources. A program to replenish and further increase the scientific potential of the academy, which envisages the training of 5—10 doctors and 80—100 candidates of sciences every year, has been developed here and is now being realized. We are getting support for this undertaking from the leadership of the Air Forces. The commander-in-chief, with his sights set on the long term, has approved the range of dissertation topics through 1995, and approved a plan to equip the academy with models of new-generation aviation hardware and armaments and the unique equipment without which the process of training engineering personnel is inconceivable.

Experience testifies that the replenishment of the scientific- pedagogical potential of the higher educational institutions takes place principally through the training of graduate students within their own walls. Taking this circumstance into account, and so as not to scatter manpower and resources, it would be worth concentrating this work, in my opinion, only at the military academies and leading higher educational institutions of the branches of the armed forces that have well- developed experimental bases and scientific schools as compared to other educational establishments of the Ministry of Defense, as well as expanding the rights of chiefs at the higher educational institutions to select worthy candidates in the ranks to be admitted to graduate study and to determine the times for the start of their study.

The necessity of a comprehensive approach to strengthening the intellectual potential of the Air Forces furthermore suggests the expediency of instituting the standard positions of professor, docent and apprentice instructor at the higher educational institutions for servicemen, and academic secretaries of the specialized and academic councils at the academies.

I think it would not be revealing any great secret if I were to mention the fact that the supervisory personnel of all the higher educational institutions without exception of the Ministry of Defense of the Russian Federation will have to search for additional sources of material and technical support for the teaching process, under the conditions of sharp cutbacks in appropriations for the development of science, and in particular military science. Matters are still proceeding, frankly speaking, with some difficulty owing to a lack of experience. The necessity is thus arising of creating an economically accountable scientific-research center at every higher educational institution, the chief direction of the activity of which would be to choose the sale of the "scientific and technical products" of the higher educational institution and to obtain additional—I emphasize, extrabudgetary—funds for the further development of the educational and scientific bases, the resolution of problems of social protections for the personnel etc. Such a center should undoubtedly function within the context of stipulated legislation, under the monitoring of the command, the financial bodies of the educational institution and representatives of the scientific community.

There is another problem of no small importance that was vividly revealed during the years of "restructuring" in the former USSR, and has remained topical for the armed forces of Russia today as well. I have in mind the drop in prestige of the military education of the youth. I am profoundly convinced that the necessity of certifying a number of the higher educational institutions of the Ministry of Defense of the Russian Federation, and first and foremost the military academies, has become acute within the process of reforming higher schooling. I feel that such a step would make it possible for them to become competitive not only within the state, but at the international level as well, and would ensure an appreciable influx to them of both Russians and foreign servicemen.

The proposals that I have expressed must naturally be considered through the prism of the educational process of each higher educational institution separately. I hope that they will find reflection in the policy of military reform, and will help us to preserve and augment the scientific-pedagogical potential of the armed forces of the Russian Federation.

Way to Ease Technician Shortage Using Warrant Officers Proposed

93UM0856K Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 32-33

[Letters by Major V. Pupkov and Major S. Timofeyev under the rubric "Military Reform: Problems of IAS": "Where to Get Technicians?—*(Two Letters on One Topic)*"]

[Text]

Break the Stereotypes

Much is being said and written today on the lack of social and professional protections for aviators of all categories, but I think that the officers of the IAS [aviation engineering service] with secondary education are in the most difficult position. Judge for yourself: a lieutenant who is a graduate of a VATU [military aviation technical school] comes to a line unit in the post of aircraft technician, servicing group technician (standard procedures) or a specialist of a technical crew. And that is effectively his service ceiling. The higher positions, after all, are engineering ones.

It happens in real life that an officer technician who has not received higher education (very often owing to circumstances beyond his control) is named the chief of

a flight or detachment TECh [technical maintenance unit], a servicing group or technical team, or even the chief of a group for standard servicing operations for the TECh of a regiment. But this is, after all, a breach of standard positional discipline. The positions correspond to the ranks of senior lieutenant or captain.

I knew quite a few good aviation specialists, conscientious and disciplined officer technicians, who served for 25 years or more at an airfield and were discharged into the reserves at those ranks. Many of them strove to keep learning at one time, but were not able to attain their dream owing to retraining on new aviation hardware, a shortage of people, combat duty etc.—they were not able to become engineers, although I repeat that many of them possessed profound knowledge and unparalleled organizational abilities.

Graduates of the higher aviation engineering schools, as a rule, are first assigned to technical positions. After two or three years of service they are transferred to engineering positions as chief of a flight or detachment TECh, a servicing group (standard operations) or a technical team.

And they serve an average of three to five years in this, their first supervisory position. They forget a great deal over this time, and the information they received at the higher educational institution becomes partially outdated. When some of them "grow up" to be a commander at the regimental level, they thus have to learn all over again.

I consider correct the decision to institute a term of study at the VVIA [Air Forces Engineering Academy] imeni N.Ye. Zhukovskiy in which an officer technician receives higher military education rather than higher special education (as before), *i.e.* primary training for engineers and training for supervisory engineering personnel are combined. This would give the graduate broad prospects in the service.

I am deeply convinced that the posts of chief of a flight or detachment TECh, chief of a servicing and standard operations group, assistant chiefs of IAS for an air squadron (in the training air regiments), deputy commander of an air squadron for IAS and positions close to them are not engineering positions in the full sense of the word in the new standard organizational structure of IAS. They could full well be held by officer technicians with the appropriate additional training. Engineering positions are the regimental engineers by fields, the chief of the TECh and the deputy commander of the regiment for IAS—that is, those that require the profound engineering analysis of the good working order and combat readiness of aviation hardware on the scale of a regiment, along with the ability to supervise large collectives.

I have become convinced through personal experience that competent officer technicians could successfully perform duties up to deputy commander of an air squadron for IAS (commander of ATO [airfield technical support]) inclusive. A powerful incentive in the service would then appear for them—the prospect of official advancement and promotion. Technical positions for such categories as engineers by fields and chief of regimental TECh could also be instituted in the training air regiments of flight schools equipped with training aircraft of relatively simple design.

I propose somewhat of a re-organization of IAS as a whole as follows (I think that these measures could be carried out in stages over several years).

First, the positions of aircraft technician, servicing and standard operations group technician and positions equal to them could be made senior warrant officer rather than officer positions. The air training regiments have such experience, where servicemen in these categories are successfully handling the duties of technicians and supporting a considerably greater yearly flying time for aircraft in high-quality fashion than in the line units.

The screening of candidates for the positions of technicians could be conducted among warrant officer mechanics, NCOs on extended duty and conscript servicemen, as well as among civilian youth.

Their training should be conducted at warrant officer schools, according to a special curriculum and with a regard for the level of professional knowledge of the trainees. The cadets should study profoundly the design and operation of the type of airframe that they will be servicing in the units during these training sessions. The future technicians should acquire skills in organizational work with subordinates.

The level of sophistication of the warrant officer schools must be raised and brought closer to the level of the military aviation- technical schools. They should train specialists as warrant officer mechanics for a term of 1.5—2 months, and senior warrant officer technicians for 5—6 months. The military rank of senior warrant officer is conferred on the graduating technician with the successful passage of exams and the receipt of certification of completion of the school. He completes graded evaluations according to specialty for the engineers of the regiment, and begins independent work under the monitoring of officer technicians in the unit.

Second, the graduates of the VATU should be assigned to officer positions in the IAS, starting with chief of a flight or detachment TECh, chief of a servicing group or their equivalent. These positions should be defined as technical rather than engineering. Some changes in the program of training cadets at the VATUs need to be made for the high-quality training of such specialists. The profound study of the design and operation of specific types of aircraft, the acquisition of durable skills in decoding the materials of on-board recording gear, the practicing of algorithms for finding and eliminating flaws in aviation hardware, making use of experience in servicing it, and the training of future officers in organizational work with the military collectives of the IAS up to squadron inclusive should all be envisaged in them.

Third, a permanently operating system of training specialists for higher positions should be created in the Air Forces. The training of candidates in special courses at technical or engineering higher educational institutions or at the staffs of large units and formations would be expedient for IAS. The program of courses should be composed with a regard for the knowledge, skills and abilities that could be needed by the trainees in the corresponding categories when working with personnel and on aviation hardware. Classes on the design and operation of aviation hardware could be conducted by the instructors of higher educational institutions, and on the organization of IAS operations and increasing combat readiness and flight safety by the engineers of the larger units and formations. Such courses should be one-and-a-half to two months long, but saturated with information.

Fourth, each officer—regardless of his education—should have real prospects for service advancement. The main criterion for his assignment to a higher post should be his attitude toward the service and the fulfillment of his official duties.

Major V. Pupkov (Krasnodar VOLTU)

Trust the Warrant Officers

It is no secret that the aviation engineering service of our Air Forces is experiencing difficulties. One of them is a chronic shortage of technicians. An attitude has taken shape toward this profession as a minor one for some reason. Who is to blame for that?

First of all, it seems, those who are obligated to train and cultivate the IAS specialists and provide professional and social protections for them. The attempts that have been made at short-term courses to train technicians at the military aviation-technical schools have unfortunately sunk into oblivion. There are no open opponents to the ideas of the authors. But it is a paradox—matters never move further than talk. I will try and confirm this with statistical data. I make no claim to absolute completeness of the data in my possession, but it testifies eloquently to the unenviable position of the IAS.

I was able to visit four aviation units where aircraft of various types are being operated. They are stationed under relatively favorable conditions. The people are more or less well provided for. The shortcomings that are able to be revealed would thus be average ones for all of the Air Forces, as it were. What was I able to find out?

The units are staffed with officer technicians and engineers in such a way that they are, at a minimum one, out of six specialists short. The question of where the graduates of the Air Forces technical schools are is a natural one. Some 354 young specialists have come here over the last ten years. Sixty nine of them were "lost" virtually irretrievably to the IAS over that time—34 transferred to other service, and 35 were discharged into the reserves. One out of five VATU graduates, in short, lost touch with the IAS over the ten years. It turns out that each school trained two full classes for... the national economy and filling vacancies in support units.

There is another fact of no small importance as well. Forty one of those remaining advanced in the service, and 17 went for training at military higher educational institutions in their fields. Isn't that where the "floating" level of education of IAS officers comes from?

The problem of technical personnel staffing levels for the IAS cannot be solved by calling up reserve officers for two years of service after their completion of civilian higher educational institutions, since these people are by and large in the army temporarily. According to the data, only 53 of the 237 people who came to the aviation units from civilian life over the last decade remain in the ranks of the Ministry of Defense.

The large understaffing of the IAS with technical personnel is thus obvious. Is there a way out of this situation? I think there is. This problem can moreover be resolved at the local level in most cases. The aviation units have able specialists (the discussion here concerns warrant officers) who want to perform the duties of technicians and senior technicians. Just give them the opportunity to study up in special courses, and they are ready technicians, chiefs of servicing groups and the TECHs of detachments and flights...

I am confident that a warrant officer who becomes an officer will serve until discharge into the reserves for age reasons or based on total time served. Why not make use of that? The sad statistics would change immediately, it seems, if we were to do that. In favor of the IAS.

Major S. Timofeyev (Achinsk VATU)

Overview of Problems in Organization of Ukrainian Air Forces

93UM0856L Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 4, Apr 93 (signed to press 8 Apr 93) pp 39-40

[Article by Lieutenant-Colonel M. Syrtlanov under the rubric "Military Reform: In the Air Forces of the Commonwealth Countries": "In Independent Flight"]

[Text] Ukraine was among the first nations of the Commonwealth to declare its right to resolve issues of military organizational development independently. The uncompromising stance of Kiev on the question of the formation of a national army did not suit everyone, but to give them their due, it made it possible to set about the practical realization of the conceptual framework for the creation of air forces in the republic in a very short time.

Many associate the successful emergence of this branch of the armed forces with the name of the commander—Lieutenant-General of Aviation Valeriy Vasilyev, whose

service was linked with the former Odessa and Carpathian military districts for many a year. The commander himself had this to say: "My emergence as an aviator really did take place on Ukrainian soil. And every officer would agree with me that one cannot in good conscience fulfill one's military duty without being instilled with respect for the history and traditions of a people whose peaceful labors you are entrusted to protect. That is why the aspirations of the Ukrainians for sovereignty, for the genuine right to dispose of their own fate, including on questions of defense, are near and dear to me. I am proud of the fact that I have been entrusted with the command of the Air Forces of a nation, in whose annals are inscribed in golden letters the names of scientists, designers and pilots who were trailblazers of the skies and space: Nikolay Kibalchich and Yuriy Kondratyuk, Igor Sikorskiy and Aleksandr Mozhayskiy, Sergey Zhukovskiy and Sergey Korolev, Arkhip Lyulka and Oleg Antonov... I believe that this feeling of participation in the cause of all generations of countrymen is shared by all fliers who have sworn their loyalty to Ukraine, holding to its policy of independent development within the framework of conciliar statehood."

The economic crisis and other negative phenomena of our times have undoubtedly had an impact on military reform in Ukraine as well. A particularly difficult situation has taken shape in the Air Forces—the most technically sophisticated branch of the armed forces.

This is, first and foremost, the problems with logistical support for the combat training of fliers as expressed in shortages of fuel, spare parts and assemblies. It would be erroneous to explain, as some politicians are attempting to do, that all of these needs are from the very fact of the proclamation of its independence by Ukraine and difficulties in relations with the countries of the so-called near abroad. The author, who has visited many of the units, sees the reasons in the disruption of economic ties among enterprises and the overall decline in production. I can say, knowing the situation in other regions of the former Union, that things are no better—if not worse—there as well.

What is the way out of this situation? We must obviously be realists. The leadership of the Air Forces of Ukraine have intentionally reduced the pace of flight training, taking into account not only the amounts of reserves of material resources, but also changes in the international situation and the lessening of military confrontation in Europe. They are striving, that is, to provide a level of combat readiness thereby that diplomats have defined as precisely the level of defensive sufficiency. The struggle to raise the efficiency of combat training has also been called upon to play its role in the cause of providing a climate of economy.

The level of proficiency of the Ukrainian aviators makes it possible to hope for a rapid transition of the national Air Forces to a new rhythm of combat training. They do not conceal the fact, however, that the personnel issue is quite acute. The taking of the military oath of loyalty to Ukraine, after all, forced every serviceman to make an unequivocal choice of citizenship right from the start. Whatever may be said, the very necessity of deciding was unexpected and was perceived quite painfully for many. And it is entirely natural that some fliers announced their desire to return to their native lands, to other republics of the CIS. Quite a few vacant positions appeared as a result, especially squadron commanders. That is why the careful screening of candidates for the open positions is underway everywhere in the regiments even today. The results will not be long in coming. We are thus talking about temporary difficulties, and in no way a hopeless situation. If we look to the more distant future, then with a certain reconfiguration of some of the aviation schools located on the territory of Ukraine they will be able, to all appearances, to train their own national cadres for all the branches of aviation.

I will say, anticipating the readers' question, that the personnel problems in the local areas are being considered, wherever possible, through the lens of ensuring social protections for the personnel. The officers believe that a series of pieces of legislation will soon make it possible to provide all families of servicemen with housing and all- round incentives for their martial labors.

Quite a bit of work really does lie ahead if we are talking about the strategic tasks of military reform. A conceptual model for the creation of a qualitatively new branch of the armed forces of Ukraine—the Air Defense Troops—is being considered in earnest in Ukraine; they will include the larger units and formations of PVO [Air Defense], the Air Forces and space units in an organizational regard. It is difficult to predict the results of such an experiment, and it has both many advocates and many opponents. The latter, judging by an appearance at the January session of the Supreme Soviet of Ukraine, could include General V. Vasilyev to a certain extent as well. Time will tell all. It will be necessary in any case to talk about a fundamental review of the tasks and aims of military reform of the Air Forces of Ukraine in accordance with its peaceloving foreign policy and the rationalization of the standard organizational structures of the armed forces.

Yes, Ukraine has proclaimed that it is a non-aligned nation, that it will not maintain, produce or employ nuclear weapons, and that it sees no neighboring country as a potential adversary. But this stance in no way propagates the euphoria of pacifism. The military in Ukraine have not forgotten their main task—to maintain proper combat readiness. They like to refer here to the experience of local wars, testifying to the decisive role of aviation in the attainment of victory in contemporary battle.

A separate question pertains to improving the structure of the Air Forces. The projected program envisages, in particular, gradual cutbacks in administrative structures through the disbanding of the divisional echelon. Calculations show that this measure, under the prevailing

conditions in the republic, would make it possible to increase markedly the combat potential of the aviation forces.

A body for the centralized command and control of the Air Forces has already been created on the basis of the former headquarters of the air army in Vinnitsa, to which are subordinate the operational command-and-control groups in the Western (Lvov) and Southwestern (Odessa) sectors, as well as groups for the command-and-control of military-transport aviation, reserves and personnel training.

They are also not getting by in Ukraine without cutbacks in the size of the troops. The cutbacks in personnel will be insignificant in the first and second stages of the military reform, up to 1995. This will affect officers who have served out their stipulated terms first of all. The directive issued by the Supreme Soviet and the President of the republic on the discharge only of servicemen with the right to a pension and provided with housing, as a rule, is being unswervingly fulfilled. But there are plenty of aggrieved people, since it is it simply impossible to take all living situations into account.

More significant later cutbacks in the administrative structures, support subunits, storage bases and, partly, the aviation regiments, from 1995 through 1999, will once again be through dischargees who have served out their terms or some other circumstances. This process may also be carried out in a less painful manner for peoples' fates by regulating the entering classes at the military schools.

Meetings with the army community last year revealed yet another problem, of a morale nature, connected with the re-organization of the armed forces of Ukraine. The officers were concerned at the time about whether their honorary name designations would be retained after the reformation of the units, with a right to the legacy of combat history and traditions. This question has now been resolved, I was told at the socio-psychological service of one of the Kiev headquarters, and the honorary names of the storied units and formations will be retained under the new conditions as well. Someone sensibly reasoned that the memory of heroic deeds of older generations could be a powerful factor in the indoctrination of draft youth and the soldiers of today.

The problem of the state symbol on the aircraft of the Air Forces of Ukraine has also been cleared from the agenda. A statute on distinguishing marks (emblems) for aviation units is being considered in parallel with it.

Suitable variations of samples of these unique military crests will have to be selected on a competitive basis and discussed publicly in the military collectives. A colleague of mine, ARMIYA UKRAINY newspaper staff correspondent for the Vinnitsa garrison Nikifor Lisitsa, related this to me.

I would note that the distinguishing marks of the Ukrainian Air Forces appeared for the first time on the MiG-29 aircraft that took part in air shows in the United States and Canada in the summer of 1992. That visit, by the way, was described in detail in the last issue of AVIATSIYA I KOSMONAVTIKA, which immediately became a bibliographical collector's item among the local aviators, since not all of them subscribe to it. Most of them have now understood that the contemporary specialist cannot get by without a professional periodical. Both Vasilyev and his deputies, as was reported at the secretariat of the commander of the Air Forces of Ukraine, are permanent subscribers to the journal. It has become much more substantive and interesting in the last two years, in their opinion. Such a review obligates us to a great deal. Most importantly, it forces us to believe that the collaboration between the fliers of the CIS countries in the skies and on the groud will serve the cause of peace and the preservation of friendly relations between our peoples in the future as well.

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